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JOURNAL

OF THE

Association of Engineering Societies

St. Louis

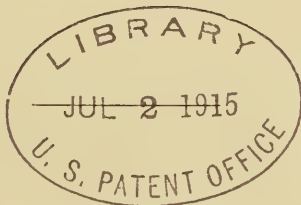
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THE INGREDIENTS OF AN ENGINEERS' CLUB

By A. P. GREENSFELDER,
MEMBER OF THE ENGINEERS' CLUB OF ST. LOUIS.

[Read before the Club, December 16, 1914.]

The custom of having a retiring president of this club write an address is so ancient that the original purpose can no longer be ascertained. Can it be that there are some who feel he should have acquired wisdom by assiduously presiding at meetings of the club? Perhaps it appears that he has not been sufficiently embarrassed by his official acts, and should be thoroughly humiliated by being required to undertake the preparation of a paper.

We admit the effectiveness of this latter hypothesis and submit to this ordeal as the proper means for the club to pursue in its determination that its erstwhile ruler shall again descend in their midst.

Our limited abilities and meager experience in life scarcely warrants advice to fellow engineers who are ripe in both. We shall, therefore, limit our deductions this evening to observations gleaned this twelve-month from our club members.

Before proceeding, it would seem wise to observe our personnel in order to clarify our thoughts as to the ingredients

of an engineers' club. A club to be eminently proper should, of course, include the customary roster of officials.

There is the *Senior Past President* who fondly hazes the freshman president, and the *Junior P. P.*, who, though a retired officer, still does not shy at committee engagements.

There must be a *President* who is willing to do as he is told and act as chairman of the "Kick" commission. Then follows the *First Vice-President*, who has all the vices but none of the perquisites of president, while the *Second V.-P.*, a good scout, dreams of becoming first, if there is no opposition ticket.

The *Treasurer* gets his just dues on this *Earth*, while the *Secretary* acts as the official scribe of deeds and misdeeds. A good *Assistant Secretary* earns all the club can afford.

All Directors must be story-tellers in order to entertain the *Executive Committee* at its luncheons. The *Programme Committee* acts as the reportorial staff, while the *Entertainment Committee* is the Jovial Host.

Let us now analyze the main body of the club. For convenience, they may be dissected intellectually, physically and temperamentally.

Intellectually, our members as individuals may desire various ratings along the scale of mentality, but properly weighted and handicapped they form an excellently matched body of human phenomena. For club purposes they should be divided according to their professional specialty or predetermined destiny. Accordingly, we can mention certain well defined groups whose tastes run in proper channels, and whose interests in special subjects are peculiarly manifest.

BRIDGE ENGINEERS, for example, might include those who delight in defiling streams or harassing railroad tracks, by erecting steel or concrete spans with or without approaches, as desired.

MUNICIPAL ENGINEERS are those who by pure merit become City Managers, but who meanwhile devote their energies to the upbuilding of civilized communities.

RAILWAY ENGINEERS comprise those who have survived as pioneers and mountaineers to become financiers and "maintainers." They can clearly differentiate between terminals and main tracks in accordance with rulings of commerce commissions.

ELECTRICAL ENGINEERS are those who deign to transmit electrically, sound, light or power, finite or infinite distances in quantities and prices to suit.

MECHANICAL ENGINEERS are those who enjoy the music of throbbing machinery, and design and create powerful appliances for saving the labor of man; and lately there have evolved the

CONTRACTING ENGINEERS, who, in spite of continued rebuffs by nature and mankind, persist in their efforts to build the structures conceived in the minds and prescribed by the pens of their more technical brethren.

Instead of enlarging upon this intellectual grouping of our members, let us proceed to survey their physical habitat.

These characteristics of our membership are usually inherited but deserve consideration in spite of that fact. The age characteristic may be fostered, however, as evidenced by the attempt of the Juniors to look mature, the Seniors to seem sprightly, and the middle aged members to appear unconcerned for the future. We see the stout jostle the lean, in frantic attempts to catch the eye of the presiding officer first, without seeming to be anxious to respond when called upon. We have the "longs" who rise high above the average in their attainments, and the "shorts" who balance with their solidity.

We discriminate between residents in the twenty mile zone, and non-residents, who discuss by correspondence. We are careful of our ASSOCIATES, and look with awe upon our HONORARIES.

We allow smokers, who require the weed to stimulate brain action, and admit "antis" who are ventilating "fans." We have those who quaff the flowing bowl and even help remove the stoppers, and we include "Prohibs" among our numbers.

We mention blondes and brunettes, not for their interesting distinctions, but for the opposites they attract on ladies' nights; and we should be lax if we omitted those with a lunch proclivity, who seem to outnumber that faction who prefer to divert such expenditures for more technical purposes.

This brings us, then, to the third and most interesting viewpoint.

Temperament may be defined as the prevailing disposition. Thus there is the distinction between the dreamer whose mind takes frequent vacations from the body, and the doer whose legs and arms acquire equal rates of acceleration with the brain.

There are those who have much ability and are modest, and some who carry their stock in trade well towards the front. There are those who demand aisle seats and those who have to be coaxed to the front rows.

We remember some jovial spirits and some who until more recent months were loth to grip the friendly hand or even discourse upon the weather.

We advertise those who are disposed to attend our meetings by enrolling their names in the red book of honor, and we have only blank dismay for the casual stragglers.

We welcome that pride in our club which induces the thoughtful member to invite guests, and we silence the "knocker" with a frown.

We enjoy the spontaneity of the prompt remitter, and hesitate to mention the anxiety caused by our delinquents.

We embrace the dutiful who contribute our papers and enliven our discussions, and hope to encourage the wayward by good example.

We differentiate between those who have the good of the club at heart, and the disgruntled who are not constructive.

Some are hospitable and invite the club to share in their achievements and partake of their good cheer on such excursions.

We encourage those of journalistic ability and histrionic talent and can endure even those who warble well.

There are progressives and "stand-patters," radicals and conservatives, and there have even been rumors of insurgents.

Thus we have an amalgamation of specialists who through their affiliation in our club continue to realize their interdependency.

Such an organization surely then has a function, if only it enables the exchange of viewpoints and experiences engendered by similar training and life work.

But, lo, we begin to awaken to even a broader realization of our powers. Tolerance of each other begets interest in our community, our State, our Nation. We begin to feel our higher destiny and reach forward towards that goal which makes brethren of all mankind.

[NOTE—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

WINTER EMPLOYMENT IN THE NORTHWEST

This report was submitted to the Executive Committee of the Oregon Society of Engineers at a special meeting, December 31, 1914, by the Committee on Winter Employment, the committee recommending that the society appoint a special committee of three members to investigate and report at the next regular or special meeting on the following:

(1) An enumeration and description of the various industries employing large numbers of laborers during part of the year only.

(2) Fluctuations in labor demand in these pursuits due to seasonal causes.

(3) The effect of periodic unemployment on these industries and on the laborers.

(4) Practicability of some system of regulation in industrial activities to avoid or minimize periodic depression from these standpoints:

(a) On physical and engineering grounds.

(b) On economic and social grounds.

(c) On grounds of legal and practical enforcement.

(5) Specific recommendation for immediate action, if any action be deemed desirable and practicable.

The committee should be authorized by the society to invite assistance in this investigation from other sources, as follows:

The city council, in regard to the possibility of deferring portions of the work of sewer construction, hard surface pavements, retaining walls, water mains, etc., to the winter months, and of the additional expense, if any, involved in so doing. Also the practicability of requiring or encouraging contractors to perform such work during the winter.

Similar inquiry of the State Highway Commission, United States Department of the Interior, O.-W. R. R. & N. Co., and S. P. Ry. Co.

The P. R. L. & P. Co., in regard to possibility of track construction work in the winter, and co-operation required from the city to make this possible.

The same with the Portland Gas Co. in regard to gas mains.

Valuable information might also be obtained from the

Lumbermen's Association, the Oregon Agricultural College, and other similar bodies which may be suggested.

Special attention should be given to the additional expense incurred by doing work in the winter, the preparations and precautions necessary to make such work possible, the effectiveness of labor thus applied, and the reduction in ordinary wages required to make it financially practicable to work in the winter season.

The present purpose of this investigation should be educational only, and should be directed toward the possibilities of making winter work profitable.

J. P. NEWELL,
E. G. HOPSON,
D. W. TAYLOR,

Committee.

The same men were appointed as a committee to carry forward the investigation as outlined in the preliminary report given above.

ORRIN E. STANLEY, *Secretary*.

[NOTE—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

QUANTITY SURVEYING

The following report was read at the annual business meeting of the Engineers' Club of St. Louis, December 2, 1914:

To the Members of the Engineers' Club of St. Louis:

Gentlemen:—Your Committee on Quantity Surveying held a meeting soon after its appointment and made arrangements to meet thereafter in joint conference with similar committees from the St. Louis Chapter of the American Institution of Architects and the Building Industries' Association of St. Louis. At the first of these joint meetings it was decided that at the next meeting each of the three component committees should submit in writing its views of what was desired to be accomplished by the joint committee and the three papers submitted were to be harmonized into a set of articles forming a basis for the committee to work upon.

The committee from The Engineers' Club was the only committee submitting such a paper and the articles submitted by it were unanimously adopted by the balance of the joint committee. The articles submitted and adopted follow:

First. That the general consensus of opinion is averse to the present system, and in favor of the "Quantity Survey System" of estimating.

Second. That the architect or engineer should furnish to each bidder a list of quantities, in accordance with the statutes or custom covering same, attached to the specifications, and that this list of quantities be made a part of and incorporated in the contract entered into between the owner and the successful contractor.

Third. That the question of who is to compute the quantities be left to the architect, i. e., whether he wishes to make the computations in his own office, or have a professional estimator make them and any change from the original plan affecting the quantities shall be adjusted by the estimator.

Fourth. That this public estimator be a bonded officer, who shall guarantee a reasonable accuracy in his computation, and state limits of accuracy for the various items.

Fifth. That a measurement law be enacted, or at least a custom established, outlining the method of computing quantities, so as to reduce to a minimum any dispute as to the correct method of estimating work.

Sixth. That the fee for estimating these quantities be paid by the architect to the public estimator, and that the architect decide for himself whether he wishes to include this fee in his own fee, or simply specify that all bidders must allow for the amount of this fee in their bids. This fee would then appear in the list of items furnished.

Seventh. That the amount or reasonableness of the fee will depend upon the class of structure, but that a definite schedule of fees for estimating different classes of structure be established.

In accordance with Article 4, the committee from this club prepared and caused to be introduced in the Municipal Assembly of St. Louis an ordinance creating the office of Quantity Surveyor, this ordinance was passed by both branches of the assembly and was approved by the mayor on November 7, 1914, and is now a law.*

A bill, requiring that all architectural and engineering plans of public work in the state be accompanied by a detailed list showing the quantity of each material used in the work, has been prepared by the joint committee for introduction in the State Legislature at Jefferson City this winter.

It is hoped that this bill will pass and by having the Quantity Survey System used on public work we hope to create a custom that will soon extend to all private work of any consequence.

* In compliance with Article 5, the joint committee is now considering standard methods to be used in computing the quantity of each kind of material to be used in a structure. This will require a large amount of work and considerable time and can only be done after consulting with a number of specialists in each line of the building trades.

The advantages to be gained by the adoption of the Quantity Survey System as we see them are briefly as follows:

1. Reduced overhead charges to the contractor.

*See copy at end of this report.

2. The contractor is given the time he now spends in figuring quantities, to superintend his job and see that it is run properly.
3. It prevents getting a job through error in taking items from plans, and by reducing risk should reduce percentage added for contingency and also cost of bond on work.
4. It causes plans to be made more definite and does away with obscurities.
5. It definitely settles the question of what is and what is not extra work on the job and does away with the consequent bickerings and law suits.
6. It makes the bids truly competitive, as all contractors are bidding on the same items.

Respectfully submitted,

J. T. DODDS,

E. C. DICKE,

C. O. FISCHER.

ORDINANCE No. 27737.

An ordinance to appoint certain persons as Quantity Surveyors.

Be it ordained by the City of St. Louis, as follows:

Section one. The Mayor by and with the approval of the Council may appoint any number of competent persons, who shall be skilled in building construction and estimating as quantity surveyors.

Section two. Each quantity surveyor so appointed shall give a good and sufficient bond to the City of St. Louis in the sum of Ten Thousand dollars, conditioned that he will faithfully perform the duties of quantity surveyor under said appointment, which bond must be executed by the appointee, and at least two good sureties, to be approved by the Mayor and Council, and no such bond shall be approved unless each of the sureties thereon be the owner of real property assessed at not less than one-half the amount of the bond.

Section three. Any person who may employ such quantity surveyor, and who may sustain loss or damage by reason of the negligence, incompetency or misconduct of such surveyor, shall be permitted to bring an action on the bond of such surveyor in his own name in any court having jurisdiction in the premises; provided, that any such action shall be brought within

five years after the expiration of the commission of such surveyor.

Section four. The quantity surveyors so appointed shall be commissioned and hold office for the term of four years from the respective dates of their respective commissions, and they shall charge for their services such fees as shall be agreed upon with the parties desiring their services, until such time as a joint committee from the Engineers' Club of St. Louis, the St. Louis Chapter of the American Institute of Architects, and the Building Industries' Association shall recommend a definite schedule of fees for estimating different classes of structures, when the schedule of fees so recommended shall become the legal fees for quantity surveyors.

Approved, Nov. 7th, 1914.

[NOTE—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

REFUSE COLLECTION AND DISPOSAL

By E. N. STACY.

[Read before the Civil Engineers' Society of St. Paul].

It is the writer's intention to touch only briefly on the various phases of this subject, as it is beyond the scope of this paper to go into the matter in as thorough a manner as should be done in order to present the matter intelligently to you. Therefore, we will only refer briefly to the main points in question, hoping that by so doing it will bring up a discussion covering the particular problems of your own city.

Since time immemorial, and wherever and whenever people have been congregated, whether in the formation of tribes, villages, towns or cities, there has always been the problem of the collection and disposal of the refuse that accumulates by such congregation. The primitive method for the disposition of waste food stuff is the same as that employed at the present time in country districts; namely, pig-feeding. This method, however, had to be discontinued when the individual families congregated as in villages, as the keeping of pigs became a nuisance and was prohibited by the village or town ordinance.

As a natural result, and following the natural inclination of mankind to cart refuse away to some low, out of the way place, the village dump came into existence, and has for centuries been an eye-sore and a menace to the health of civilized communities. The dump is still maintained by a large number of cities and towns in this country. There are also several cities whose garbage is delivered to hog ranches, regardless of the fact that the hogs become diseased and are the means of spreading disease and death through contaminated meat. Besides these hog ranches, adjacent to any city, are objectionable and unsanitary.

Another method of disposal is that of dumping into rivers and carrying out to sea. This has been prohibited by the government to a large extent on account of the floatage coming to shore in case of dumping in the sea, and on account of the filling of the channel and contamination of water for drinking purposes in the case of dumping in rivers.

Another method of disposal for small cities and towns is that of burying. This requires considerable unused land, necessarily

expensive, adjacent to the city thereby creating a nuisance and expense in hauling and spreading. This method is used by a few cities in this country.

Another method of disposal that has come into existence and which is being practiced by some of our larger cities, is what is known as reduction, or in other words, the "cooking process." In this method, the garbage only is treated, or handled, and certain by-products, such as grease and tannage are obtained, the remainder being used as a fertilizer in some cases and in others burned. This method at best creates a nuisance and, therefore, must be and always is situated well out from the center of the city, necessitating an expensive system of collection, and, although certain by-products are obtained as a point in favor of this method, the increased cost of collection and delivery more than off-sets the saving. The following are a few reasons why reduction plants should not be built:

1. Health is of more value than money, and the primary trouble is that garbage disposal in a large city ought not to be regarded as essentially a business for obtaining profit. The health and comfort of the public is the first consideration, and profit is entirely subsidiary to it. The first question to be asked with respect to the subject is, how perfectly can the work be done? Just as long as profit is the uppermost question, and reduction plants are always installed and operated for that purpose, just so long will there be infringement of public rights.

2. Garbage and refuse cannot be treated and destroyed at the same reduction plant, and it is therefore necessary to keep two disposal plants with two sets of men and establishments where garbage and refuse are handled separately.

3. Where reduction plants are operated, all the garbage of the city is generally called for, causing law-suits. Individuals cannot be compelled to turn over garbage; they can dispose of it as they see fit.

4. Reduction by boiling in rendering processes produces odors which cannot be eliminated, and that reduction plants are a nuisance is testified to by reports from fifteen different cities in this country having used them at some time or other.

5. Reduction plants should not be tolerated on account of the fact that the operators of the plant must work in unsanitary surroundings, because they are a menace to the health of the

community, and, lastly, because they only provide for the partial disposition of the city's waste.

In mentioning the above methods of disposal, we have said nothing about the various ways in which the refuse may be collected and transported to the place of final disposition. In the very smallest villages, each householder generally gathers the refuse around his premises and hauls it to the dump. In small towns, the municipality generally takes the responsibility of collecting the refuse, and payment for the same is provided by taxation. In a few cities, a fee of a certain amount is charged per week or per month, but this has been found to be unsatisfactory on account of the fact that the householders will dispose of their refuse in some other manner and at a less expense, and often in an unsanitary manner. It is therefore advisable that the municipality, no matter how small, provide for systematic collection of all refuse of the city and the transportation of same to place of final disposition.

It is always advisable for cities to provide steel wagon boxes with covers, so that no nuisance will be created by the wagons passing through the streets. The design of these boxes must be such as to adapt themselves to the handling of the refuse at the place of final disposition. A great many cities are adopting the method first used in Minneapolis about five years ago, of requiring the householders to drain garbage of all moisture and wrap it in paper before placing it in the garbage can. This keeps the can clean at all times and prevents the garbage freezing to it in cold weather, and sticking to it in hot weather, and where this method is used it is only necessary to provide tarpaulins as covers for their wagon boxes, as then the garbage can be piled high above the top of the box when necessary.

The methods of disposal mentioned above would make it necessary that refuse of all kinds be hauled to some distance outside of the city for final disposition, thereby entailing a large expense. We are now to describe the method most generally used, one where all classes of refuse can be destroyed without creating any nuisance, and that at the least expense for collection and destruction. We refer to the method of incineration.

Fire is the oldest and best known method of disposing of offensive rubbish. It has been adopted by all races and in all ages with more or less satisfaction. Where cities have used dumps

they have been able to burn a good deal of refuse there and, in fact, nearly every dump is burning continually the year round. However, this only adds to the unsanitary condition, as the smoke and fumes from the burning dump float over the city and surrounding country, filling the atmosphere with germ-laden fumes. It is therefore necessary that the burning be done in some kind of a furnace, and the investigation of this furnace, or incinerator, as it is called, is what we will attempt to describe in the following pages.

The incineration of all refuse has long been conceded by health authorities as the only sanitary method of disposal. Where the method of incineration is used the dangers from disease by any other method is avoided. The incinerating plant can be located so that the hauls will be short, thereby reducing the cost of collection very materially, and it has been found that where municipalities have been paid a certain price for the delivery of their refuse to a reduction plant that they can effect a saving by building their own incinerating plants in locations where the haul to the plant will be short, and the amount saved will more than off-set what they have received from the reduction plant, plus the interest and depreciation on the cost of installing the incinerating plants.

The first incinerator in the United States was constructed in 1885 at Governors' Island, New York, by Lieut. H. I. Reilly, U. S. A., and the first municipal incinerator was built in the same year at Allegheny City, Pa., by L. P. Rider. This incinerator had a capacity of 30 tons in 24 hours, the contract price being \$5,700.00. Since that time there have been about four hundred different installations for municipalities, varying widely in design. Out of this number of installations, over 50 per cent have been permanently discontinued after short periods of operation. One of the reasons for this is that a large number of them were experimental, and another reason is that their builders thought that any kind of furnace would burn garbage and refuse, and disregarding its composition and not taking the time to think out or apply the correct principle of the application of heat to the refuse, a large majority of incinerators were constructed in such a way that the heat could only attack the refuse on top and burn down, instead of the reverse, which should be the case in an incinerator of correct design. Another reason is that the inciner-

ators have been operated by incompetent employes who have been appointed to their positions for reasons other than their fitness for the work.

We may add further that the municipalities themselves are responsible in no small degree for some of the failures of their incinerating plants. The question of refuse disposal is purely an engineering problem and in the majority of cases the committees appointed to investigate and report on the various designs of incinerators available, are not competent to make a selection that would prove satisfactory. There is no reason why machinery should not be sold on its merits to municipalities as well as to individuals, but heretofore politics has had altogether too much to do with the purchase of municipal apparatus, and until competent engineers are employed on the committees, who can investigate and report uninfluenced politically and without personal or party prejudice, we may expect a great number of failures of incinerating plants.

It is not within the scope of this article to go into the classification or analysis of the various kinds of municipal waste, as the percentage of these materials vary greatly in different localities and in different seasons of the year, but the following is about the average:

Garbage	25 per cent
Refuse	25 per cent
Ashes (in Northern cities).....	50 per cent
<hr/>	
	100 per cent

Garbage is generally known as rejected food waste. Its usual weight is about 800 to 1500 lbs. per cu. yd., and it ordinarily contains from 70 per cent to 85 per cent moisture. These figures are, of course, exceeded in melon and fruit seasons in Southern cities, or at rainy seasons of the year.

Refuse includes all combustible matter, such as wood, paper, house sweepings, street sweepings, discarded clothing, mattresses, straw, rags, broken furniture, also glass, iron, tin cans, crockery, etc. The usual weight is about 300 to 900 pounds per cubic yard.

Ashes are not unsanitary and do not become so if hauled to a dump, and they can therefore be used for filling in low places about a city, or in road-making, and we will not therefore con-

sider them as refuse to be hauled to an incinerating plant, although some manufacturers of incinerators require them in order that they may be mixed with the wet garbage to reduce the percentage of moisture in same in order that it may not be detrimental to the interior fire brick work. We think it useless, however, to haul ashes to an incinerator, as it requires extra labor to handle them through the plant and then they must be hauled away again at an added expense.

In considering the various illustrations that follow, we wish to state that we have arranged them consecutively so that, starting from Minneapolis, the first illustration will be of the Milwaukee plant, and we will then go east as far as Halifax, N. S., thence south into Florida, west to Los Angeles, north to Portland, Ore., thence east again through Canada and back to Minneapolis. We will try and bring out a number of points in explaining the illustrations that we have not as yet touched upon.

The illustrations cover a number of different designs of incinerating plants and illustrate a variety of methods of handling the different kinds of refuse. Some of these illustrations are not as clear as they should be owing to the photographs being taken in cloudy or damp weather, and interior views being taken without flashlight.

Going east from Minneapolis, the first plant of importance that we come to is the Milwaukee plant built by the Power Specialty Company of New York. This plant is equipped with Heenan & Froude furnaces. Capacity, 300 ton in 24 hours. The refuse in Milwaukee is collected in steel boxes, these boxes being handled by crane at the plant. Their contents are dumped into bins on the upper floor, the different materials being put into separate bins. In the process of feeding the furnaces, laborers are employed to mix the ashes with the garbage, or the garbage with dry refuse before depositing it into the hoppers. This process is unsanitary and expensive.

A large number of men is employed at this plant, and its operation has been characterized by high cost ever since its installation. Until recently the steam has not been utilized, but at present a plant has been installed a short distance away, equipped with centrifugal pumps for flushing the Milwaukee River, and some of the steam from the incinerator is now utilized, but no reports are available as to just what the saving amounts to.

The design of the furnaces is such that the refuse drops onto a drying hearth in the rear and is pulled forward onto a trough-shaped grate. Forced draught is used, but no induced draught, with the result that when the stoking doors are opened a volume of black smoke pours out of them, which makes it very disagreeable for the operators. There are four units in this plant, each unit consisting of a series of six grates, and each unit being connected to a water tube boiler. The plant has only been burning about 175 tons per day on an average, as one of the units is out of commission most of the time on account of repairs being necessary. A large amount of dry refuse or ashes are used to mix with the garbage, and when this is not available coke dust from Sarnet-Solvay Company is hauled in by the carload and weighed in as ordinary refuse. This, of course, contains a large percentage of combustible and by this means they are able to operate the plant and maintain fairly high temperature. However, the cost of operating this plant is practically prohibitive, and the unsanitary conditions on the charging or feeding floor that cannot be overcome makes it not altogether likely that the city of Milwaukee will be looking for a more efficient method of disposing of their refuse before very long.

The 600 yd. disposal plant shown in Fig. 1 was built by the Decarie Incinerator Company of Minneapolis. Its location in Rochester, N. Y., is in the business part of the city. Dry refuse only is hauled to this plant.



Fig. 1. 600-Yd. Disposal Plant, Rochester, N. Y.

The building is 200 ft. long, 55 ft. wide, and is substantially constructed of brick, concrete, and steel, and is fireproof throughout. The plant is operated by the city of Rochester, who also maintain their own system of collection.

At the bottom of the refuse bins is a conveyor, on to which the refuse is raked. This conveyor is 4 ft. wide and runs the entire length of the building. As it passes from the lower floor at the level of the bottom of the refuse bins it rises to the level of the second floor and passes through the picking room, where men stand around each side and pick out paper, rags, tin cans, bottles and anything that can be utilized. The paper is bailed up in 500-pound bails. Bottles are sold for 1 cent a piece, rags go with the paper to the paper factory, and tin cans are pressed and sold to foundries for making sash weights. The steel bins shown along the side of the conveyor are supported on concrete beams and extend down to the bailing presses on the lower floor. The conveyor is of a special design for handling refuse and does not become clogged. It was furnished by the Jeffrey Mfg. Company. Late reports from this plant state that it is operating in a perfectly satisfactory manner, and without the necessity of closing down for repairs since its installation in 1911.

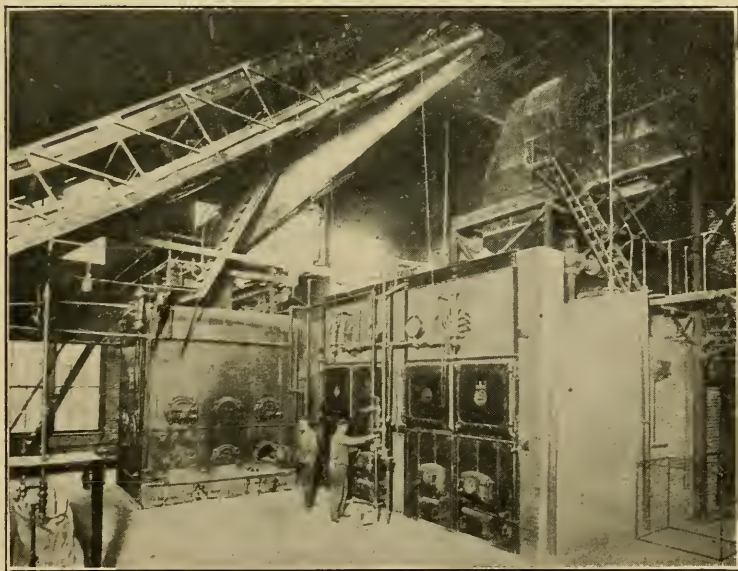


Fig. 2. Boilers and Incinerator, Rochester, N. Y.

Fig. 2 shows the boiler room of this plant. Note the end of the conveyor at the top of the photo. The refuse that passes the pickers comes out this conveyor and goes down the steel chute by gravity into the incinerator. The incinerator has a capacity of burning 600 cu. yds. per day, and is of the all-steel, water-jacketed type, built and installed by the Decarie Incinerator Company, Minneapolis. The hot gases from the incinerator pass into a battery of Keeler boilers, there being two units, 220 hp. each. The steam from this plant is sold to Rochester Light and Power Company and is piped directly from the boiler into their mains. It is conceded by all who have visited this plant that it is without doubt the best plant of its kind in America.

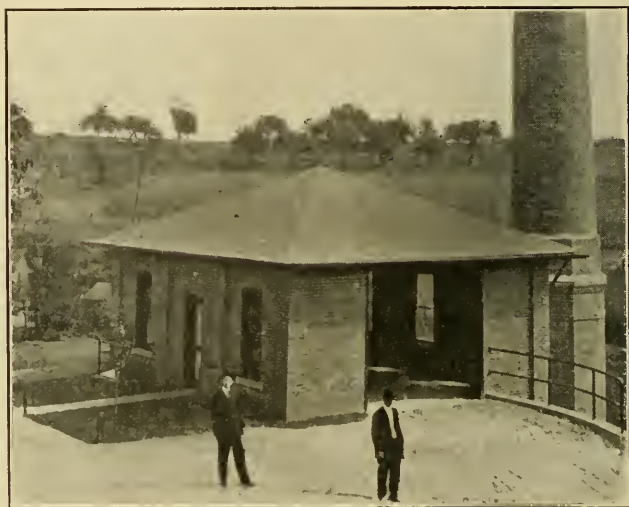


Fig. 3. 20-Ton Plant, North Braddock, Pa.

The twenty-ton plant, North Braddock, Pa., was built by the Decarie Incinerator Company in 1911. This, we believe, is one of the neatest little plants ever built for small towns, and it has proven very efficient and economical in operation. The plant is fireproof throughout, the building being brick, concrete and steel, with slate roof. The chimney is of radial brick construction, 3 ft. 6 in. diameter, by 125 ft. high. Equipment is all steel of the Decarie type. Forced draught is used, the air being heated by a steam coil heater. Every city or town of 10,000 or over should have a plant of this kind.



Fig. 4. 20-Ton Plant, North Braddock, Pa.

A side hill makes an ideal place for a plant, as it simplifies the approach to the charging floor, and the plant, as illustrated here, can be kept as neat and clean as the premises about any building. Hot and cold water and steam connections are furnished on both floors for cleaning and sterilizing the wagons, carts or any apparatus used in connection with the collection of the refuse.

A 60-ton plant at Wheeling, W. Va., was built by the Decarie Incinerator Company in 1909. This plant is operated by natural

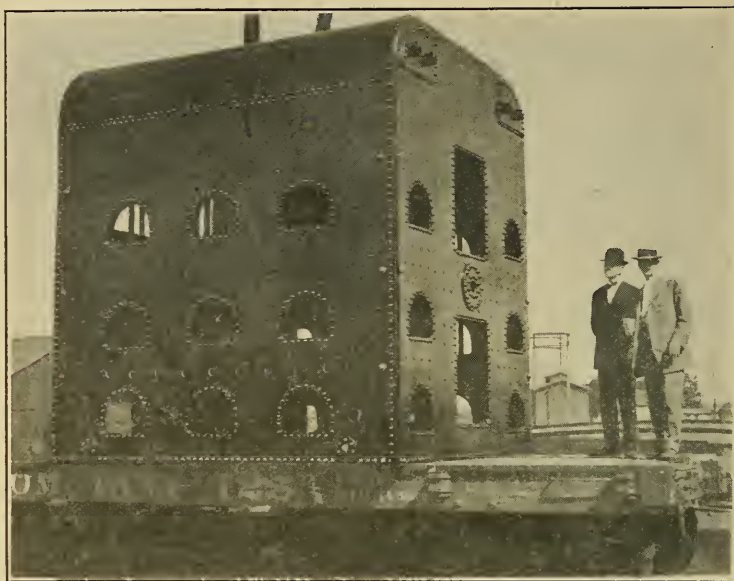


Fig. 5. 60-Ton Furnace. Wheeling, W. Va.

gas as a fuel, and is the largest plant of its kind in the country operated in this manner. The equipment is all steel, the main unit being shown in Fig. 5, ready for shipment. A recent report from this plant states that it is working satisfactorily, consuming garbage entirely with no fumes.

The all steel construction insures durability, does not need re-lining, as do brick furnaces, and with ordinary care they will last fifteen or twenty years.

The forty-ton plant shown in Fig. 6 was installed in Wilmington, N. C., by the Decarie Incinerator Company in 1913, having been put in operation about Aug. 1st. A report from Wilmington, under date Sept. 19, 1914, and signed by Chas. T. Nesbit, reads as follows: "Decarie Incinerator used thirteen months constant burned 16,000 tons, cost 26 cents a ton, no repairs, no storage or sorting refuse, highly satisfactory."

The refuse making up this 16,000 tons consisted largely of slop, watermelon rinds, condensed fish, and trash. There was also during that time 229 horses and 14 cows burned. We believe that this is a record that cannot be equaled by any other plant of the same capacity in existence. It might be noted that



Fig. 6. 40-Ton Furnace, Wilmington, N. C.

this plant was rated forty tons in twenty-four hours, and the report for the thirteen months shows that the average tonnage destroyed per day of twelve hours was 48.6, or more than double the rated capacity.

A plant at Savannah, Ga., recently put in operation, was built by the Destructor Company, of New York, at a cost of \$126,000.00. It consists of two 65-ton per 24 hours Heenan and Froude furnaces, one 200 hp. Wickes Vertical Boiler with preheaters and forced draught fans. The garbage and refuse is dumped from the carts into a large pit at the ground level. It is then lifted by a grab bucket and transferred by a monorail hoist to the hoppers of the furnace. Some idea of the atmosphere in the interior of this building can be imagined when a mass of wet garbage is allowed to stand in a large pit for any length of time, and, to say the least, the handling of material in this plant is unsanitary and unhealthy for the employes of the plant, to say nothing of the odors that emanates from the building. At the present writing, this plant has not been accepted by the city. The builders figure an annual saving to the city of over \$12,000, but this is only theoretical and must still be shown in actual practice.

The Dixon Company built a large number of plants, mostly in units of small capacity, for small towns, government forts and camps, but the design of their furnace was open to the same objection as the large majority of brick furnaces are, namely, they had to be re-lined often at a large expense, and the cost of operation averaged between 85 cents and \$1.25 per ton. The company went out of business about a year ago, having had the record of installing a large number of plants, and also the record of having the largest number discontinued on account of high cost of operation and maintenance.



Fig. 7. Lewis and Kitchen Incinerator, Steubenville, Ohio.

Fig. 7 shows the exterior of a Lewis and Kitchen incinerator at Steubenville, Ohio. This incinerator is built along the same lines as the Dixon plants. Many of them have been built in small units in small cities, towns and forts, and many have been discontinued for the same reason as the Dixon plants. This company, too, has gone out of business.

The plant shown in Fig. 8, built by the Nye Odorless Crematory Company, of Macon, Ga., consists of a brick furnace having a large door in one end and two short chimneys about fifteen or twenty feet high. The dead animals and refuse are dumped on to a car, as shown in the cut, and the car then run into the furnace and the door closed. Coal is fired on a grate at the right of the large door, the flames passing over the refuse in the car.

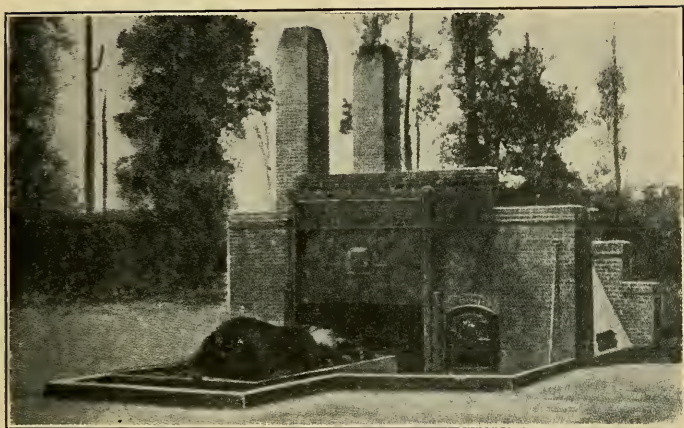


Fig. 8. Nye Odorless Crematory.

Radiated heat from the brick arch is depended upon to consume the refuse. Large volumes of smoke ordinarily surround this plant when in operation, and a great deal of coal is used.

Fig. 9 represents the Thompson Incinerator at Galveston, Texas, built by the Webber-Duller Company. The incinerator consists in reality of an enlarged base of the Webber chimney, that is, it is cylindrical in shape and lined with fire brick, and has a series of flat grates on to which the refuse is dumped. Dry refuse only is handled at this plant; that is, comparatively dry, as all very wet garbage is taken to the dump. The ash pile in the foreground of the picture shows that the refuse is not nearly all consumed, and the plant is not considered to be efficient or economical in operation. Only two or three of these plants have been built.

Fig. 10 shows the Fred P. Smith Destructor at Pasadena, Cal., consisting of two forty-ton units. The units are constructed of brick, the refuse being dumped into tanks, which are elevated in much the same manner as the cement, sand, and rock are elevated and charged into a concrete mixer.

The building is of very good design of concrete, and has a pleasing exterior. The furnaces, however, do not fulfill the guarantees of their builder in the matter of cost of operation, temperatures and maintenance. In design, the furnaces are much the same as the Lewis & Kitchen and Dixon types. Mr. Smith, of



Fig. 9. Thompson Incinerator, Galveston, Texas.

the Smith Destructor Company, has been employed for many years by the Lewis & Kitchen Company.

Fig. 11 is a photo of one of the recording pyrometer charts from the Smith plant, taken on an average line, showing that the average temperature is about 950 degrees, instead of sixteen hundred, as was guaranteed.

The cost of operation in this plant was guaranteed not to exceed 38 cents per ton, and in actual practice for the first six months averaged a little over \$1 per ton, according to reports obtained from the city officials.

The high cost was due, in a certain sense, to the city not delivering the material in large enough quantities.



Fig. 10. Fred. P. Smith Destructor, Pasadena, Cal.

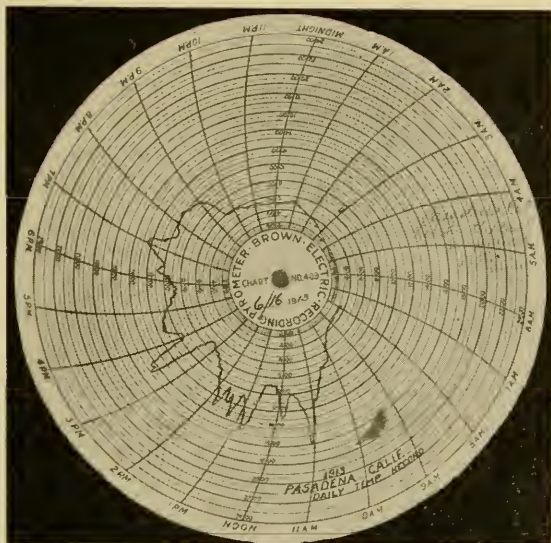


Fig. 11. Recording Pyrometer Chart.

The Heenan-Froude plant at San Francisco was built by the Destructor Company, of New York, and consists of two units of 60 tons each, built at a cost of \$260,000.00. This plant was contracted for in 1912 and the price above mentioned was for two plants, called the Islais Creek plant and the North Beach plant, of equal size. The Islais Creek plant only has been built so far, it having been in operation over a year, and at last report had been rejected by the city engineer.

The plant at Berkeley, Cal., was built by the Griscom-Russell Company. The furnaces are of the English Sterling type, fed by the clam-shell bucket method, as in Heenan-Froude plants. The city engineer of Berkeley made a tour of inspection and investigation before finally deciding on this design. The plant was built in 1913 at a cost of about \$60,000. After the city had operated this plant for a few months under a very heavy cost, in August, 1914, this plant was shut down and the city returned to their former method of running the garbage out to sea.

In selecting this plant the mistake was made in installing equipment not designed to handle the refuse of American cities. This mistake has been made by a number of cities in this country, with the resulting loss of a large amount of money and the con-



Fig. 12. 120-Ton Plant, Spokane, Wash.

sequent loss of confidence in all makes and designs of incinerators. If equipment had been selected that had proved successful in handling refuse, such as we have in our American cities, it would have shown better judgment on the part of the officials making such selection.

The plant shown in Fig. 12, built by the Decarie Incinerator Company in 1908, was the second plant contracted for by the city of Spokane with this company. The first plant was a 40-ton unit installed in a wooden building. In the new building, the old 40-ton unit was installed, together with two new 40-ton units, all of the steel, water-jacketed type.

The city of Spokane charges the householders a fee for collecting their refuse, with the result that the city only collects about 20 tons per day instead from 100 tons to 120 tons that they would collect if the city had a free collection. The result is that the cost of operating at the plant is somewhat higher than it would be if the plant was run to capacity. Reports show, however, that the fees obtained just about pay for the collecting and burning of the refuse.

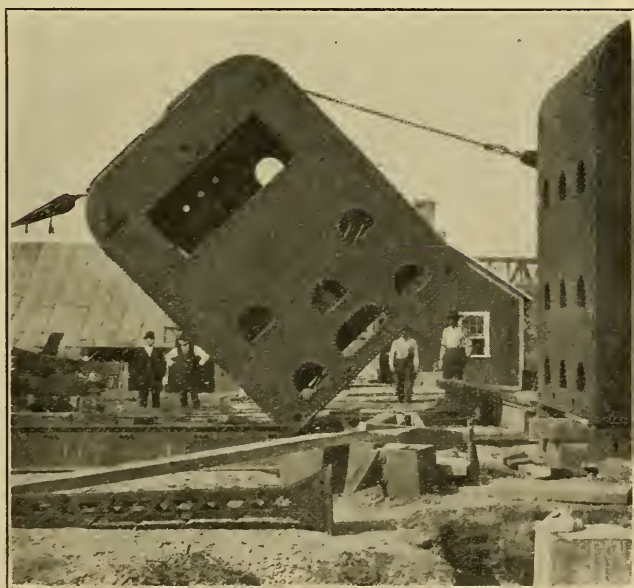


Fig. 13. Decarie Incinerator, Spokane, Wash.

The handling of the Decarie incinerators at the Spokane plant is shown in Fig. 13. Note the size and the heavy steel construction. This design precludes all possibility of early deterioration, as is the case in incinerators of brick design. In some places these incinerators have been in constant use for fourteen years, with a cost for repairs almost negligible and no other type or design has proved as efficient and economical in operation. They will handle anything from the driest refuse to the wettest garbage and slop, and the primary principle of the suspension of the refuse in a basket grate so that the heat and flame can attack it on all sides directly cannot be improved upon.

These incinerators are made in units anywhere from one-half bushel capacity to 75-ton capacity, and are adapted for handling all classes of refuse. Ordinarily very little fuel of any kind is needed, but natural gas, fuel oil, coal or wood answer equally as well.

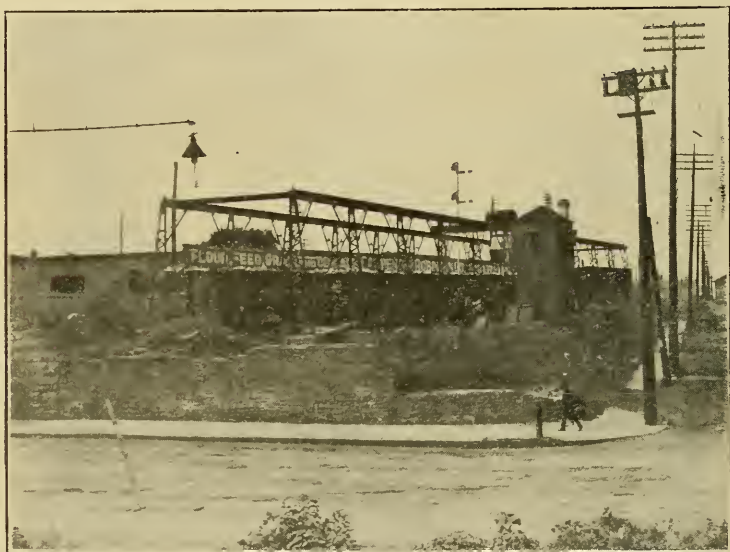


Fig. 14. Refuse Loading Station, Minneapolis, Minn.

The central loading station in Minneapolis is shown in Fig. 14. The garbage tanks are all hauled to this point and lifted by crane from the wagon to flat cars. These cars are then hauled to the incinerating plant, which is located on the city's farm in

North Minneapolis. Twelve tanks are placed on each car, and the net weight of the refuse in each tank is about 2,500 lbs.

The incinerators in this plant were installed fourteen years ago. Two wooden buildings have burned down over them, but they are still doing business. At present, this plant is heating and lighting the city workhouse, the old and new tuberculosis hospitals and furnishing steam for cooking in these institutions, also furnishing current for 210 arc lights in the Tenth Ward. The installation consists of two incinerators, one Wickes boiler, forced and induced draught fans, two 175 K.W. generators and one 50 K.W. generator, together with feed pumps, switchboards and the usual accessories for a plant of this size. The incinerators are of the Decarie type, although not of the latest design.

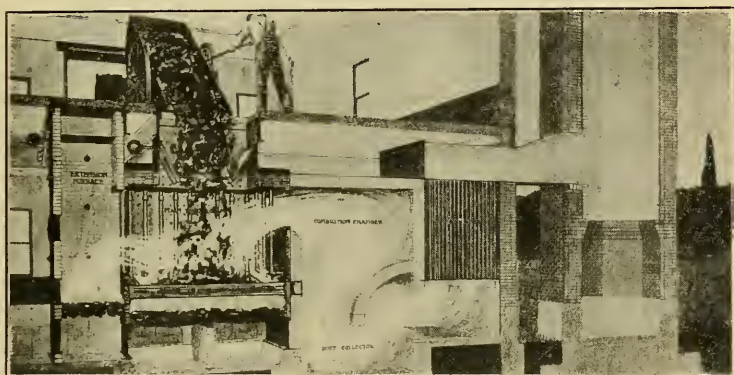


Fig. 15. Typical Section of a Decarie Incinerator.

Fig. 15 shows a typical section of a Decarie incinerator. It will be seen that the load of refuse is dumped directly through hopper opening in the charging floor into the incinerator, where it is held suspended by a basket grate over a lower fire on the lower shaking grates. By this method the fire attacks the refuse directly on the bottom and all four sides of the basket, and any dry refuse that there may be burns at once and assists in the burning of the wet material.

During the last three or four years there has been a demand for incinerators for household use. Fig. 16 shows a design called the White Vulcan type, built by the Decarie Incinerator Company. This is a gas-operated incinerator, the same principle be-



Fig. 16. Incinerator for Household Use.

ing used as in their municipal types, namely, that of the refuse being held suspended in a basket while the flames from the special Bunsen tubes attack the refuse on all sides, as shown in Fig. 17. A central perforated chamber is provided for the escape of the products of combustion so that an explosion of the gas is not possible. The three and one-half bushel is shown in Fig. 16, and in this size a lower fire grate is provided when it is desired to use other fuel.

These incinerators are constructed of heavy cast iron insulated on the outside, and having an outside casing of heavy white

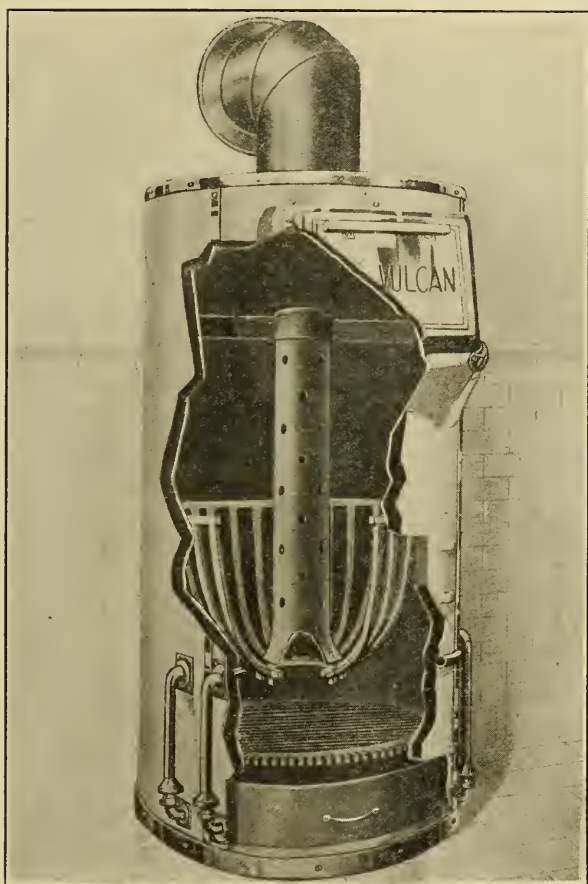


Fig. 17. Interior View of Household Incinerator.

enamel plates. They are substantially built and are economical in the use of gas.

There are a large number of different types of these household incinerators on the market, but their sale is confined to the better residences, flats, apartments, hospitals, hotels and public buildings.

Each burner on these incinerators uses 20 ft. of gas per hour, and they are arranged so that one burner may be used or the entire number of burners as desired, so that if a little care is taken in the operation, the minimum amount of gas may be used for any kind of material.

In the average operation of the one-bushel type, one bushel of wet garbage may be destroyed per hour using 80 to 100 cu. ft. of gas.

The writer has tried in the foregoing pages to present just a brief outline of the subject of incineration and to describe a few of the incinerating plants now in operation in this country.

Much progress has been made in the design of incinerating plants during the last seven or eight years, owing to the fact that engineers have given the matter attention, while in the earlier stages of the installation of these plants they were largely built by inventors and experimenters with little or no technical knowledge.

It is to be hoped that in the future, progress will continue to be made and that every city and town will do away with unsanitary means of disposal, fall in with the city planing idea and build disposal plants that are clean and sanitary and of pleasing architecture.

If more detailed information is desired on any of the plants that have been mentioned, the writer will be pleased to furnish any information that he has upon request.

[NOTE—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

A PLEA FOR BEAUTIFUL BRIDGES

By H. G. TYRRELL.*

[Read before the Oregon Society of Engineers, Dec. 11, 1914.]

In view of the large expenditure for new bridges which Seattle has under consideration, some suggestions as to their design and construction will be interesting to western engineers, and to the residents of that city.

"Bridges" has indeed been an interesting subject in Seattle, ever since the bill was introduced in the city council last January, asking that an election be held in March to vote on issuing about two million dollars in bonds for these structures. Although the motion was defeated at that time, it is generally admitted that these structures are needed and must soon be built, if progress in this direction is to keep pace with other improvements.

That these bridges be built according to the best modern practice and specifications, is most desirable, for so large an opportunity for city beautifying is rarely offered at one time, and it is most fitting that one of our progressive western cities should set an example to the rest of the world in artistic bridge building.

The other achievements of this western metropolis, and its brief history, are evidence that the best may be expected in this direction. Seattle's wonderful development is indeed almost unique, even in American history. Beginning in 1852 with only a few scattered houses, it had increased to a town of 3,500 inhabitants in 1880, and to upwards of 40,000 when the great fire of 1889 burned over one hundred acres. Since that great conflagration, the city can claim the distinction of rising to its present proud position in little more than twenty years.

The topography of Seattle, with its hills and valleys, makes it particularly interesting to the bridge builder, for the one element of height is present, which more than any other, gives distinction and impressiveness to such structures. The presence of the ship canal from Lake Washington to the Sound, also adds the interesting features of opening spans for the passage of ships. Conditions are, therefore, inviting for the

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building of fine bridges, which may be made important features in the ultimate city plan.

The enterprise which Seattle has exhibited in its development is further assurance that its bridge building will be carried on in a large way, and structures reared that will be a credit and ornament to the community, large enough for the increased traffic which will certainly develop with its rapid extension, and beautiful enough to be worth preserving. In that city, hills over 300 feet in height have been washed down and the earth run out on the flats, thus making new land for extra streets, and all of this has been accomplished at remarkably low cost. The millions of money that have been spent on these improvements is a guarantee that large enough appropriations will be provided for bridges of the best type, and not simply for make-shift ones, as are so often found in new communities.

Seattle has, indeed, at the present time, an opportunity for beautiful city planning that it never had before and may never have again. No objects about a city, and especially one like Seattle, on undulating and hilly ground, are so conspicuous as its bridges. They stand out above water, unobstructed by the surroundings, and cannot be hid. This condition is well illustrated in some of the cities of Central Europe, where every bridge is a structure of architectural beauty, and not simply a utilitarian construction supporting an elevated platform for travel.

The bridges that Seattle builds now, will doubtless remain for many years, and if they be made beautiful they will be attractive objects which visitors will remember as public works worthy of a great American city and indicative of the public spirit and enterprise of its citizens. In works of this kind, erected in the twentieth century, the motto should be "build beautifully now," and the city will then rise on pre-conceived plans, and progress steadily forward without retrogression. The need of systematic planning is all too evident in many of our older cities which have been extended in haphazard fashion, only to be torn down in large part and built in the best way that the hampered conditions will permit.

It is now well known that the best plans for bridges and other public works are usually obtained through the ser-

vices of thoroughly competent and disinterested consulting engineers. Patent proprietors of movable bridges are often induced by the prospective profits, to incur large expenditures to bring their inventions before the public notice, even exhibiting them in some cases through the medium of moving pictures. But all such insistent efforts only go to show that the chief benefit from the adoption of patent types usually goes to the patent proprietors and not to the community. Consulting engineers know that in many cases, if not in all, the best types of opening bridges are those which have long been in use in Holland, modified in some cases to suit local conditions and modern materials. Most of these old types are not patentable and are therefore not so often brought to public notice, for the simple reason that they are not a source of patent royalties. Chicago and Milwaukee, where more opening bridges are found than in any other American cities, long ago adopted the ancient trunnion type of bascule, and Philadelphia has since followed in the same line. Many of the modern patents are merely modifications of types used in Holland and other European countries, long before permanent bridges of any kind were thought of in America.

The claim is often made that opening bridges are more difficult to beautify than fixed ones, and cities are persuaded to accept uncouth plans which result in no improvement to the district. The result is that ungainly and awkward frames are reared at our water crossings, void of any lines of beauty, when beautiful structures should and could as well be made. The excuse for ugly framing and discordant outlines is a false one, for bascule spans can be made quite as attractive as any others, and they have the additional interesting and useful feature of opening when needed for the passage of water craft. The Duwamish river bridge in South Seattle, might just as well have been made attractive as ugly, and the difference in appearance can best be appreciated by comparison with such a structure as the Tower Bridge at London, or some of the very attractive designs presented for river crossings at Chicago, Toledo and Washington.

It is greatly to be hoped, therefore, that Seattle will secure bridge designs which are not only serviceable, but which will conform with the best plans for city beautifying, and be a credit to that progressive western metropolis.

It is a singular fact that a much greater degree of artistic merit in bridge design, than is now usually applied, existed long before the present generation, which has made such rapid strides in all other lines of mechanics and engineering. This is easily proven by reference to some of the very earliest bridges, such as those made by the Romans, twenty centuries ago. The oft quoted Pont du Gard was built in the fore part of the First Century to convey water to the city of Nimes in France. For the succeeding centuries it has continued to be a model for aqueduct builders, as may be seen by reference to a recent one near Rome, and to our own High Bridge at New York, which, however, has only a single tier of arches. Pont du Gard, which crosses the Garden river, is said to have been built during the reign of Emperor Augustus under the direction of Agrippa. Of its three stories, the lower one contains six arches, and the second, eleven arches above the lower ones, while the upper, or third story, has thirty-six small arch openings supporting the water duct. This old bridge has a wonderful history. More than one hundred and fifty years ago, extensive repairs were made and the lower arches were widened to carry a roadway at one side. The lower arcade originally had four separate rings side by side and not bonded together, and the second tier had three similar rings. Repairs were also made early in the Fifth Century, after it had been partly destroyed by the barbarians.

Examination of the structure shows that aesthetic treatment was well considered by the early builders. It seems, indeed, that it is only within the last half century that this phase of bridge building has been so sadly neglected.

Two other very interesting bridges in European cities are those which spanned the Thames at London and the Arno at Florence. These bridges were both covered with shops and the old one at London had guard towers at each end. They were built about the same time, but it is believed by many that another bridge crossed the Thames nearly two hundred years before, though records on this matter are quite indefinite. The London bridge was completed in 1176, about the time that the historic one at Avignon are said to have belonged to the ancient order known as in France was begun, and the building of these structures

"Brothers of the Bridge." It seems rather unfortunate that the practice of lining the decks with shops has been so generally abandoned, because in some cases, such features are appropriate and convenient. As a general rule, however, it is better to leave the river view unobstructed above the balustrade, but in certain places where the view is not attractive, little would be lost by a line of shops at each side, particularly if the sides have open arcades as on the old bridge at Florence. In those days, the custom seems to have been to honor the builder of a bridge by placing his remains after death, in a vault deep down in one of the piers, the custom being a rule of the bridge building "brotherhood."

The end towers of old London bridge are said to have been favorite places for exhibiting the heads of decapitated traitors. The piers of this bridge were so thick that they originally occupied two-thirds of the whole waterway and formed a serious and dangerous obstruction to the river flow. A similar damming of rivers with numerous piers has recently resulted in increasing the overflow in the flooded cities of Ohio. At that time, the citizens of London found the heavy piers of London Bridge so objectionable, that when rebuilding it, the piers were placed much farther apart, and a like arrangement will doubtless be carried out when rebuilding those in the inundated regions east of the Mississippi.

The story of many old bridges in European cities is full of tragedy and romance. The old one at London, soon after its completion, took fire at the south end and great crowds of spectators from the city gathered on the other end to watch the sight. Fire then started on the north end of the bridge and the people were hemmed in between the two fires. Those that were not drowned were burned. Two hundred years later, a whole block of houses became loosened from the deck and, with its occupants, toppled over into the river. In later years other fires did serious damage, and in the middle of the Eighteenth Century the houses were all removed and toll charges were discontinued.

The bridge over the Arno at Florence is by far the most interesting of the four old ones in that city. It has shops on each side and an upper foot walk between them, forming a passage way between two adjoining palaces. It has the

remarkable width of 105 feet, much greater than many of our recent ones in America.

The city of Budapest has at least two very fine suspension bridges crossing the Danube, the first having been completed about sixty-five years ago, from plans by the eminent Irish engineer, W. Tierney Clark. The towers are plain but elegant, and the graceful curves of the cables give beauty to the design. The bridge was severely tested soon after its completion, when for two days the Hungarian army retreated across it, followed by thirty thousand Austrians, both armies having cannon and heavy ammunition wagons. The other suspension bridge at Budapest which was only recently completed, is likewise a model of elegance and simplicity. It has eyebar cables and steel towers pivoted at their base, and the design is the combined work of engineers and architects.

Some of the finest monumental bridges in Europe cross the Rhine in Germany, among which may be mentioned those at Bonn, Dusseldorf, Mainz and Worms. The Bonn bridge contains a central span of 615 feet, over the middle of the river, with deck arches at each side. Monumental portal towers are prominent features in all these designs, forming as it were, gateways to the deck. Some of the towers are supplied with such useful features as clocks and weathervanes, and that at Bonn has heavy and elaborate detail on the metal portals, which would hardly be appropriate for any other location. The similar bridge at Dusseldorf with two main arches instead of one, as at Bonn, has a prominent central pier on which is mounted the figure of a lion. If any criticism of the Dusseldorf bridge were permissible, it would be in reference to this pier, which is rather small for the magnitude of the adjoining spans. The tower details are of the finest character and the twin spans over the middle of the river have bold but graceful curves. A somewhat similar bridge over the Rhine at Mainz has three river spans and monumental portal towers.

Other beautiful city bridges are those which cross the Rhine at Worms, and the Aare at Berne, both of which are deck arches instead of half-through, as at Bonn and Mainz. The Worms bridge was completed about twelve years ago, and is remarkable in that the arch ribs are built to exact curves instead of being a succession of segments. The lo-

cation at Berne was quite different in its natural conditions to the others, inasmuch as the roadway is high above the water, permitting a very much bolder arch than those across the Rhine. An unfortunate feature of the bridge at Berne, as far as the aesthetic treatment is concerned, is that the floor is on a grade of nearly three per cent, and yet the design has been so carefully studied out, that the lack of symmetry from the rising grade in one direction, is hardly apparent or any detriment to its beauty. It is about 1,000 feet long and cost \$426,000. The Bonn, Dusseldorf and Mainz bridges cost respectively, \$637,000, \$900,000 and \$1,300,000. These costs are undoubtedly high when compared with those for many city bridges in America, but when the beauty of the designs is considered, there can be no doubt whatever, that the money was well spent. Because of their prominent location, bridges offer opportunities for aesthetic treatment, and often for fine monumental features, which is often quite impossible in city buildings surrounded by other blocks. It is well known, moreover, that fine bridges add character and distinction to a city, and returning travelers will remember monumental ones long after the city buildings have been forgotten. Bridges are indeed among the greatest attractions to travelers and tourists, and it is probable that the fine ones of Europe have in themselves, attracted enough tourists to those countries to more than pay for their construction.

When commenting on the beautiful bridges of Europe, we do not mean to say that all the fine ones of the world are there, because, though scattered, we already have quite a number of attractive ones in America, though perhaps of smaller proportions. The little one in the Public Gardens at Boston, is very familiar to visitors in the East and to New England people. In the summer time, this little suspension bridge is surrounded with a great variety of plants and flowers and the lake beneath the bridge is a favorite resort for pleasure seekers. Along the water edge beneath the trees are benches where pedestrians find a shady retreat in the hot days of summer. In another park bridge at Madison, N. J., an arch is used instead of a suspension. A feature of the design is the electric illumination which is accomplished by means of a system of globes on ornamental iron standards.

One of several designs prepared by Mr. Paul J. Pelz, the

well known architect of the Congressional Library at Washington, and Captain T. W. Symonds, engineer, for crossing the Potomac river at the national capital, was proposed more than twenty-five years ago, but nothing was accomplished until recently, when the matter of its construction was again brought before Congress, and an appropriation made for its commencement. The design is in classic style with two triumphal arches mounted with equestrian groups in bronze, and lower towers at the sides with arched openings. The details of the columns are Corinthian, as are also those on the minor towers near the ends. These great arches on their heavy piers with rounded ice-breakers, form a massive central feature and mark the position of the bascule openings and channel. It is greatly to be regretted that such a design as this, reflecting so much credit upon the aesthetic phase of bridge building in America, should not come at once to fruition, as others have in Europe.

The great Hell Gate arch with a span of 1,000 feet, which is now being built under the able direction of Mr. Gustav Lindenthal, will be the longest arch span ever completed, and one of the longest ever projected. It forms a part of a long viaduct connecting two lines of railway from the mainland to Ward's Island, at New York. Provision is made for four tracks on a stone ballast deck, 140 feet above the water, high enough for masted ships to sail underneath. The arch rises to a height of 300 feet, and as originally designed, the towers were of red granite concrete on grey granite bases.

Very few of the bridges mentioned here, excepting perhaps those in parks, are suitable for exact reproduction in American cities, and yet it is quite as easy to evolve designs which are architecturally meritorious and suited to their conditions, as it was to prepare the designs shown for other locations, including the beautiful ones in Europe. It is, in fact, merely a matter of suiting the design to the location, a problem which the illustrations show to have been successfully accomplished elsewhere.

When asked some years ago by the authorities of Copenhagen, St. Petersburg and Sydney, to prepare designs for bridges in those cities, the invitations were declined by the writer with great reluctance, because of the opportunity for artistic designs which are usually acceptable in the capitals

of foreign countries. It is interesting to note that the accepted design for at least one of these bridges—that over the Neva at St. Petersburg—was the work of an American engineer.

[NOTE—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

GENESIS OF THE TRACTION ENGINE

By J. L. MOWRY.*

[Read before the Civil Engineers' Society of St. Paul, December 14, 1914.]

To James Watts must be given the primary credit for the modern steam engine. As early as 1759, one hundred and fifty years ago, his attention was called to the possibility of a steam driven carriage. The first successful carriage of this type was produced by a French army officer in 1770.

Sixteen years later, Oliver Evans asked the Pennsylvania Legislature to grant him monopolistic control of the application of steam to propulsion of wagons. There were numerous carriage conceptions in Europe and America during the next forty years until Stephenson came out with his railway locomotive in 1825.

The horseless carriage for ordinary roads soon took a back seat for the one destined to eclipse all others for speed and cheapness of overland transportation.

The first record of a steam plowing outfit in the United States was in 1858, when a J. W. Falks, Pennsylvania, operated a two-cylinder, 9x15 engine, geared to a barrel-shaped drum, six feet wide, pulling eight plows. The bulge of the driving drum made turning more easy. Steam was supplied by a vertical boiler.

Eight years before this England records the use of a portable engine geared to a windlass pulling a plow back and forth by means of a cable. A little later a double plow frame carrying two sets of plows, right hand and left hand, did away with the necessity for turning at the ends. The use of an engine at each end reduced the amount of cable necessary. This latter system is still used in England and has been tried out in this country in some areas which are rough or covered with shrubs and therefore extravagant of energy when the engine immediately precedes the plows. In such places the cable plow gives a good account of itself. It has been used in the mesquite lands of Texas with some success.

The device for allowing drive wheels to move at different speeds was perfected in 1870, after forty years of experimenting. With the development of the friction clutch the trac-

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tion engine became more usable through ease of manipulation.

The next fifteen years, up to 1890, witnessed rapid progress in the perfecting and use of steam traction engines. A few began to use the large threshing engines for plowing, but found, that with the horse plows available, it took much help, viz., a man for each plow in addition to engineer, water hauler and coal team. Only the larger engines were equipped with gearing and clutch heavy enough to stand the heavy lug.

It will be interesting here to note the evolution of the present fallacy of steam engine rating. There was a temptation and desire to use more power than furnished by ten or twelve horses on a sweep threshing rig. The effort was made, but the engine was too small. Owners of horses knew that threshing was hard work on their work animals. It was an exceptional team that could follow a threshing outfit all fall and not be badly out of condition. So the manufacturer brought out another engine which did fairly well, but was not equal to emergencies. It was called at 25 hp., and the farmer was skeptical. The next engine to appear was large enough to do the work, but it was a 36 hp.

The sale of this size was destined to be slow, so the sagacious manufacturer said: "We will call this a 12 hp. engine," in order that the over size might get by the purchaser.

There were other prejudices also. The steamer made threshing harder, although faster. It pleased the separator owner to thresh more bushels, also the farmer's wife, for the crew had to be fed a less number of meals. Horses were afraid of the steamer, which made shock threshing unpopular. Then, again, the grain came through too fast to be cared for by hand measuring. Most of the drawbacks were overcome with the addition of the self-feeder, wind stacker, and the self-weigher.

It is interesting to note that to this date there is only one steam engine manufacturer who is not rating according to this 1 to 3 schedule.

A horse is supposed to be a horse. As a matter of fact the average is only about three-quarters of a horse. A horse should pull about one-tenth of its weight, and 150 lbs. is

the figure used in calculating hp. But more horses are under 1,500 lbs. than are over. A steam traction engine is about 48 to 60 per cent efficient at the draw bar, that is, it will deliver a dhp. for each 800 to 1,100 lbs. weight on firm ground, or a bhp. for 400 to 550 lbs. of weight.

Grief comes to the engine operator, however, because of the lack of reserve power. A horse may pull three times 150 lbs. for a short time, and for an instant has been known to exert a pull equal to its own weight. Steam and gasoline engines are under rated only about 15 to 20 per cent. The steam pressure may be raised in the one case and add to the power, provided time will permit harder firing, but the gasoline motor has no provision for emergencies.

Another set of conditions under which all traction engines must operate and which is not anticipated by the manufacturer is that of road surfaces and grades as they affect the power necessary to move the engine itself, aside from the trailing loads. 150 to 160 lbs. draft will move one ton over macadam roads. It will take 50 per cent more power to move the same load in a field. It requires about 15 per cent more to move a ton of traction engine than a ton of loaded wagon on a road, due to the nature of the wheels and the hard rutted condition of the average road.

Grade affects draft by adding 20 lbs. per ton for each per cent of grade.

Velocity, as affecting draft, is negligible so far as traction engines are concerned.

It is then very evident that the margin of reserve power of a traction engine is too quickly consumed by soft footing and rolling ground to make it reasonable to expect an engine in the field to do the work of more than one-half the horses claimed for it by the manufacturer, except in the broad, level prairie country. And if the engine is going to become a part of our productive equipment, we must expect to find more of them working on rolling land than on the level areas.

Increased power consumption in transportation and the industries has served as an impetus to the encouragement of the use of more power in agriculture. Five years ago agriculture employed 8 men to the railroad's one, with 2 hp. per

man in agriculture against 60 for the railroad, and the railroad using the 60 hp. double the number of hours.

Ten years ago 5 hp. sufficed to transport each passenger across the Atlantic, now 30 hp. does the job, with added speed and luxury.

Statistics show the use of 2 hp. by 3 men operating 39 acres netted \$435, or \$145 per man per year through our Southern States. In our Northern area one man and 4 hp. was able to show a net profit of \$611.

Plowing is about one-third of the power consumption in agriculture. The application of mechanical power through special plows has been very satisfactorily accomplished. The effort, however, to adapt mechanical power to general farm work shows results far from satisfactory.

In 1903, the gasoline motor car gained a standing which encouraged the manufacture of gasoline traction engines to a wonderful degree. The past six years have recorded a progress in this line comparable with that of the automobile.

The gasoline motor has made possible a great reduction in gross weight as well as material decrease in the crew of men necessary. Designs brought out to meet special conditions have given us the following:

1. The low, wide wheel, like the steam engine.
2. The road roller, like the steam engine.
3. The high, narrow wheel, 7 to 8 ft., which will negotiate rough and soft ground with surprising success.
4. The low, wide, single wheel drive, eliminating the differential.
5. The high, narrow single wheel, no differential and in about 15 hp. size.
6. The caterpillar (two drivers and one steering) in which the weight of the machine is carried on castors which move in a groove inside a heavy steel endless chain, 12 to 18 inches wide. The chain is driven from the engine by a second chain over sprocket wheels which moves the machine and load along by raising one end of the castor track and allowing the weight to roll down and forward, or back, as is desired. The machines have a bearing surface large enough to reduce the weight per square inch on the ground to 7 lbs.

This weight is nearly equal to that of a 200 lb. man wearing an 8½ boot.

7. The auto cultivator, consisting of two high, very narrow drive wheels and a third for steering, used for row cultivation.

8. The auto plows, usually four cylinder motors with 3 or 4 wheels and self-contained plows, making a one-man outfit, good for three or four plows.

9. The motor truck, similar to the commercial truck, but with more power, and with provision for widening the wheels and adding lugs to the surface of them.

These may be divided into four classes, 12 bhp., 18-30, 40-50, 60-75, and can be depended upon to deliver 80 to 85 per cent of the rated hp., and good for about 25 per cent of their weight at the draw bar. Larger machines are to be had on special order.

The gasoline engine designer passed through about the same steps as did the steam manufacturer. He first appeared with an 8 hp. single cylinder engine and found it would little more than move itself. He increased it to 15 hp., and was encouraged. His next step was to apply a four cylinder automotor of the 30 hp. rating. This proved him to be on the right track, but the motor was light, bearings too small, lubrication inefficient, and it would not cool when running on low gear under heavy load.

There are about 70 manufacturers of traction engines in the United States. The Twin Cities can muster 17 manufacturers, supplying 23 sizes and styles of gasoline engines and three steamers. In addition, there are to be found distributing agencies for 15 manufacturers from out of the state, representing 29 gasoline and 31 steamers. We then have 32 of these 70 manufacturers here and represented, offering 52 gasoline and 34 steam, or a total of 86 traction engines—quite a family, you will agree.

[NOTE—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

REPORT OF THE BOARD OF MANAGERS FOR 1914

By JOHN W. WOERMANN, Chairman.

Beginning with the January number, the Journal has been issued from St. Louis about the twentieth of each month. At least three technical papers were published in each issue, except in the November and December issues, which contained two each. These were accompanied by the usual discussions, proceedings and obituaries. The matter which may be published in the Journal is limited by the Articles of Association, but the new management took the liberty of introducing some minor innovations such as the new cover, occasional editorials, halftones of officers, the Regulations of the Associated Engineering Societies of St. Louis and extracts from the new City Charter and proposed Building Laws of the city of St. Louis. Whether the character of the papers was above or below those of former years we leave for the members to decide. An effort has been made to make the Journal a little less formal, and an invitation is here extended to all of the societies to send in paragraphs and short articles of local interest as well as formal papers of general interest.

The management of the Journal was undertaken by the present Board under very discouraging conditions. The Boston Society, with 871 members, had given notice of its intention to withdraw from the Association on December 31, 1913, and the Detroit Society, with 270 subscribers, had given notice of its intention to withdraw on March 31, 1914. Hopes were entertained that the Detroit Society might be prevailed upon to remain in the Association, but in this we were disappointed.

The Oregon Society, which had also given notice of withdrawal, reconsidered the matter and stayed with us. Utah also contemplated withdrawing, but left the matter in the hands of a committee with power to act. Utah remained with us throughout the year, but has recently given notice of its intention to withdraw on December 31, 1914. The reasons for this action we have been unable to learn. The Technical Society of the Pacific Coast, on account of peculiar and unusual conditions, which were fully set forth in the November

issue of the Journal, decided to discontinue its meetings at the close of the year and therefore ceased to be a member of the Association at that time.

Finally, on November 19th, the Louisiana Society notified us that it, also, would withdraw from the Association on December 31, 1914. Their secretary wrote that this action was caused by no dissatisfaction with the Journal or with any of the features of the Association, all of which were eminently satisfactory, but that after some discussion among the members, it was concluded that the activities of the Louisiana Society might best be fostered by the publication of its own Journal.

In brief, three of the old societies withdrew from the Association on December 31, 1914, and the Association now consists of the societies in St. Louis, St. Paul, Montana and Oregon. This reduces the total number of subscribers from 1,293 to 863.

A serious effort has been maintained throughout the year to bring in new societies. In all, about thirty societies were written to. Some of these, like Brooklyn, Baltimore, Scranton, Harrisburg and Pittsburgh, had already established journals of their own and preferred to continue with their present plan. Others, like those of Columbus, Des Moines, Spokane, Little Rock, Providence, Morgantown, Steelton (Pa.), Tidewater (Va.), and the Pike's Peak Polytechnic Society (Colo.), were found to have gone out of existence. Other societies, like those of Washington, Kansas City, Dayton and Memphis were primarily social and have practically no technical papers that they care to publish. Others like Rochester, Syracuse, Richmond, Cincinnati, Louisville, Sioux City and Seattle, failed to take any action whatever. Some favorable correspondence was received from members of societies in San Antonio, Trenton and Idaho, but these societies have not yet acted on the matter. The Technical Club of Omaha replied that it is the consensus of opinion of that organization that it is too young to enter the Association. The Albany Society of Civil Engineers and the Engineers' Society of Eastern New York are rival societies covering the same field. We have reason to hope that they may be amalgamated and then join the Association. For the purpose of making it

easier for a new society to come into the Association, the St. Louis members of the Board of Managers submitted an amendment to the Articles of Association whereby the entrance fee of fifty cents per member was removed. . To illustrate how slowly the average club moves, it may be stated that this amendment was adopted by the Board of Managers during July and submitted to the constituent societies on August 1st, but not until November 14th had enough societies acted on the matter to permit the secretary to announce its passage.

Statements of the receipts and expenditures during the year and the Association's assets and liabilities are submitted herewith.* In brief, we may say that about \$1,800 was turned over to Secretary Peters, \$900 of which was subsequently year's salary, leaving \$900 as the net amount with which we returned to the former Secretary, Fred Brooks, for his last began business. Some unusual expenditures, such as the shipping from Boston to St. Louis of a large number of back issues of the Journal, the purchase of shelving for the same, the purchase of an Addressograph and typewriter, and an increase in the delinquency of some of the Societies reduced our bank balance to about \$700. With all of the Societies fully paid up, the balance at the close of the year would have been about \$1,000.

*To be published in the February issue.

Editors reprinting articles from this JOURNAL are requested to credit the author, the JOURNAL OF THE ASSOCIATION, and the Society before which such articles were read.

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This Association is not responsible for the subject-matter contributed by any Society or for the statements or opinions of members of the Societies.

THE ECONOMIES OF A MANUFACTURING PLANT

BY JOHN SEVERIN BRANNE,*
MEMBER OF THE ENGINEERS' CLUB OF ST. LOUIS.

[Published in advance of presentation to the Society].

The profitable manufacture of articles of commerce in any locality depends on the demand, local and more distant, and the price at which the articles can be disposed of, locally and elsewhere, to meet successfully the competition of other manufacturers. It does, therefore, appear that the undertaking of any manufacture must rest upon a purely economical basis from the very inception of the undertaking, through all its stages, from the planning, location and cost of plant; its size and internal arrangement; shop and office management; management of sales and general executive management, curtailed more or less by the board of directors in their judicial and advisory capacity; and also by the stockholders, who may be compared to the legislature, as after all is said and done they control the purse; and what is more, furnish the sinews of war.

Profitable manufacturing, depending fundamentally on the laws of economics, is thus contingent on an indefinite number of conditions requiring much knowledge and experience, and hence rest basically on the personality of the management from top to bottom, from center to circumference. Able writ-

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ers on political and social economy have contributed largely to the understanding of the continuous evolution that gives shape to the demand for human necessities, either for the individual or for the community, and the object of this article is to treat simply a few features of a more technical nature, contributing to the economy in the location and general planning of the plant, for present needs and future probabilities.

It may be well for a little better understanding to consider some statistics, here given in a very scant outline, and taken from the 1905 "Census of Manufactures," issued by the Department of Commerce and Labor, the statistics being for the calendar year ending December 31st, 1904. This census shows 339 industries, some of them generic, or having a further division, in some cases hard to split up any more, into units; nor does this take into account the "Neighborhood Industries and Hand Trades," confining the classification and statistics to the factory system proper. This being understood, the census gives the number of salaried employes as 519,751 and the average number of wage earners as 5,470,321; of this number 66.3 per cent are employed in municipalities of a population of 8,000 or over; and 33.7 per cent in the country; or as 2 to 1. A slight increase of the urban percentage appears above the 1900 census, not necessarily showing a drift to the city, but probably the tendency of rural manufacturing centers to grow into municipalities of 8,000 inhabitants or more. Of this great army of workers the relation of men to women, numerically, is about 4 to 1. In 10 industries there are more women employed than men. Child labor (under 16 years) throughout the United States decreased one per cent from the year 1900; again it decreased in 25 states and territories and increased in 26 others. The busiest months, meaning the employment throughout the United States of the greatest number of workers, were September, October, November; the greatest number employed in any industry in one month was in December, in the manufacture of cotton goods. The month having the greatest number of children (under 16 years) working was September; numerically Pennsylvania came first and Massachusetts second.

The average annual wages in the country appears as \$450.00 and in the city \$500.00. It must be remembered that

this is a general average of men, women and children for the entire United States.

The employers are placed in classes according to capital employed, by capital being meant, "Capital owned or borrowed, including land, buildings, machinery, tools, implements, cash on hand, bills receivable and unsettled ledger accounts, stock in process of manufacture, finished product" and this capital aggregated thirteen billion dollars; an increase of 41.3 per cent from 1900 to 1905. From the point of view of value of product per year, the factories of medium capacity, \$100,-000 per year, employed the greatest number of workers, 43.8 per cent.

The four leading manufacturing states are New York, Pennsylvania, Illinois, Massachusetts, in the order named; and these contained 39.9 per cent of the establishments of the country, gave employ to 54.5 per cent of our workers and reported 47.1 per cent of the value of the product.

It is interesting to note the statistics for factories owned by individuals, firms and incorporated companies:

	No. of establishments owned.	No. of workers em- ployed
Individuals	52.7 per cent	13.8 per cent
Firms	22.2 per cent	15.4 per cent
Incorp. Co's.	23.6 per cent	70.6 per cent
		Value of manufactured product.
Individuals	Wages paid 13.3 per cent	11.5 per cent
Firms	14.5 per cent	14.4 per cent
Incorp. Co's.	72.0 per cent	73.7 per cent

The motive power employed in all these factories aggregates fourteen and one-half million horse power, of which steam furnishes 73.7 per cent, gas 2 per cent, water 11.5 per cent, electricity 8 per cent—all others (not classified, but called "Others" and "Rented") 4.8 per cent.

The manufacture of food products comes first, iron and steel second, and textiles the third, as to value of the product.

The undertaking of any kind of manufacturing is primarily dependent on a demand, but also qualified, sometimes very much, by an evolutionary process, demanding some altered kind of article, its form based on improvement over present articles in the market, its contents at the same time not deteriorating, but often improved; as in the manufacture of more economic tools and machines, developed by thought and experience; or in food products so treated as to permit storage, long shipments or subjected to processes making the raw material yield more and better nourishment, or again called forth by new discoveries, or applying materials in ways not hitherto thought of, as shown in the extended use of reinforced concrete by combining the compressive strength of concrete with the tensile strength of steel; this stimulating the cement industry and the manufacture of certain steel products. These considerations will gradually renew old plants and create new ones where the latest and best tools and appliances can be provided, and in the right place. Profitable manufacturing then, the demand being assured, will depend on economy in *raw materials, fabrication and sale*.

Economy in raw materials will involve the geographical location of the plant, taking into account the location of the raw materials, and this will naturally tend to locate factories treating all primary products of the forest, farm and mine as near as such materials as dictated by shipping facilities by land or water; the bulk and weight of raw materials greatly exceeding the finished product. Tariff regulations must be considered in connection with finished product and field of demand. Continuity of demand together with shipping facilities will influence the size of the plant and permanence of appliances and buildings. The climatic conditions may curtail the available supply at times and may necessitate storage at convenient distance and free from such interruptions, that the manufacture may be continuous. *Economy in fabrication* will depend on, as stated previously, the personality of the management and subordinates, this item governing in a great measure all the others, making them at times wholly subordinate. The cost or lease of land will favor the small city or rural community, where instances occur of gift of lease or even permanent property right to land, that an active industry may react on the general property of the community.

On the other hand, the rural location will involve expenditures for building roads, sewers, and providing water, the last item being of no small importance. Again factory sites for certain industries may be wholly impracticable, either owing to space requirements or to restrictions imposed for the general welfare of a densely populated community or industries that may be somewhat of a nuisance due to noxious odors, smoke, excessive and continuous noises or general unsightliness of plant. Thus steel and iron works, coke ovens, cement plants, packing houses, saw mills are generally rural, or on the outskirts of cities. The tendency is to locate manufacturing plants which are necessarily odorous, noisy or unsightly outside the cities, that workers may get away from them after working hours. The buildings cost more in the cities, quite generally, owing to the scarcity of land which necessitates taller buildings. And being taller a higher grade of buildings for the safety of human life in case of fire; whereas the low building can spread out horizontally and give easy exit even with slow burning construction.

The arrangement and capacities of tools and appliances to gain the desirable end of economical manufacturing is another way of expressing the end to be kept constantly in view in the general and detailed planning of the plant. And not only the present needs but future probable needs are involved, affecting general arrangement and general appliances more, individual tools less. This foresight, so invaluable for every working day, is illustrated by the setting aside space in the yard as well as in the factories, for additional appliances for the furnishing of light, heat and power; for loading and unloading materials; providing space and even initial installation of freight elevators, traveling cranes; making the capacities of these latter greater than now required; thus also in carrying capacities of floors; headroom; for making entire ends or sides of buildings of a cheaper construction for temporary use; in buying outside light, heat and power for factories of shorter probable life or of small capacity. Economy depending on least work to obtain a good article must plan for efficient tools and least distance from receipt of raw materials to shipping platform, or storage house, or yard. A straight line arrangement is not always feasible, nor may it be desirable even if it were so, as there is a certain parallelity of operations at

certain stages, subdividing one stage before the next one can be reached.

The outcome of this is a series of parallel buildings of varying length and location, with a main artery, so to speak, taking in the raw material and delivering the finished product; the parallel buildings being contiguous, or close together, and having all facilities of transportation from any one to another.

As to the buildings themselves, their kind will be predicated, first, upon the nature of the manufacturing; second, upon the geographical and community location; third, upon the temporary or permanent uses they must serve. These three conditions are co-ordinate.

The nature of the manufacturing, giving its first expression in the general planning, determines the kind of materials that may be used without suffering rapid decay; and that must have the strength to support loads imposed by raw materials, machinery, finished products, appliances for intercommunication, as traveling cranes, industrial railways; by snow and wind.

The geographical and community location further eliminates materials more expensive than others, while no more durable. The lower type of building (rural) may use wood, the city building may not economically select this material, but confine itself to steel, brick, concrete; being taller and requiring more fire protection, and larger loads on the supports. Again the geographical location, disregarding community, will be the determinator, according to materials available, and their relative prices.

The temporary or permanent uses will determine the general qualities quite largely, of the materials, and is a highly important consideration. Sometimes a combination of the two may co-exist, as already stated under general planning and foresight. Clearly, less durable materials may be used; but even in the constructions avowedly temporary it may be well to consider whether some fundamental portion should not be of a more durable type, as many a small and tentative beginning has developed into a permanency.

Nor is the planning of the buildings complete before the economic working conditions of the human machines are considered. Looking aside from sociological conditions as

ably treated by others, the engineer or architect can look after some items, wholly indispensable for economical working conditions, and comprised generally under the heads of light, heat, general hygiene and protection from fire. The light and general hygiene make for factory location in the country by a large margin. There should be plenty of windows, to admit light, and they should be movable, to afford ventilation. Windows as well as skylights should be of a material giving diffused, not direct sunlight, and have wire mesh to minimize risk from adjacent fire, or falling skylight glass.

While window ventilation will do very well for industries of a cleanly and odorless kind, the ventilation may be aided largely by some active type of ventilators on the roof, which with a slow movement of outside air help to draw the air about. But in factories employing either a great number of workers in a small space, or necessarily accompanied by noxious gases, or ill smelling odors, a real fan blowing system should be used, in conjunction with the heating system; for no person can work well in foul air, which lowers vitality, numbs an active mind and sets at naught the intrinsic economy of the best planned shop and the finest tools.

What has been said about ventilation may include heat in this way, that whatever system is used, fresh air must be supplied in abundance. The hot air system seems to furnish both heat and fresh air, and deserves a full study in all cases.

Under hygiene may be mentioned the advisability of modern sanitary toilet and wash rooms; and in all economically planned factories of to-day this is given consideration as inculcating good habits and bodily comfort.

Protection from fire is fortunately receiving more attention from day to day. It is not always possible to eliminate inflammable materials as they may form the raw materials or the finished product. But the factory can be made fireproof, and this can be effected only by having incombustible materials of construction and ample exits, at a definite location, of easy access and stairs easy of descent. The definite location is of high importance, as the panicky fear numbs the sense of location except that it be deeply rooted in the mind.

That the exit or exits shall be ample sized comes next; that doors may open outwards; that the junctions of stairs meeting at successive floor levels may widen out and allow

lower floor. tenants to break into the crowd rushing down; and finally that the grade of descent may not be steep enough to cause stumbling. All narrow winding steps should be eliminated.

Based on the above conceptions two general exit types may be suggested, an inside stairs or an outside, but it must be, in either case, wholly closed by incombustible materials. There are advantages and dangers in both. The advantages of the inner stairs are worth study. The sense location which is almost wholly gone in a panic, instinctively turns to it, (the inner stairs) it is the regular building stairway; everybody knows where it is. The automatically closing door at each floor should be characteristically denoted as by a vivid coloring or inscription. This stairway, or these stairways, as the case may be, terminate in the general hallway, always fire-proof—right outside is the street and safety. The disadvantage of this automatically closed (at each floor) wholly incombustible stairway, which must be easy of access, familiar of location, easy of descent, ample of proportion, safe at its base as to street exit through the familiar general entrance hall, traversed every day, is that doors at the various floors may be smashed or left open, admitting smoke, maybe flames.

If we consider the outside stairs, this must likewise be essentially the same as the inner, same ease of descent, etc., etc., and will terminate at its base in a court or on the sidewalk. That it may fill with smoke or flame for the same reasons as before stated, seems evident. The advantages and safety in automatic sprinklers are so well understood that nothing needs be said but to commend them. Only we must be sure that the standpipe has water in it. Fire drills are advisable, and in tall (city) factories, absolutely necessary.

Interest and taxes are both apt to be higher in the city, from cost of land, cost of buildings, etc., thus favoring the smaller city, or rural location. Light, heat and power may cost less in the city for small plants. Some of the large companies furnishing these commodities have made lower rates recently. The country location, at some special place where water power is cheap, may be more economical, but this commodity is now quite rare, in the majority of states, at a low rate. For steam-making a soft coal may be used in the country, but hardly ever in the city, due to hygienic reasons.

The disposal of by-products in almost every industry has developed so much that it is now a distinct item of economy, and must be practiced where possible. Metal scrap is remelted; saw dust is used in lining ice houses; textile waste becomes paper; parts of animal waste tissue and soft bone becomes glue, and so on, in a most surprising way. And this is rightly becoming more and more recognized, as the natural resources of the country grow smaller and smaller, strict economy must be practiced.

The rural location holds out the economic advantage of a lower cost of living, entering appreciably into Economy of Fabrication. *Economy in Sales* would appear to mean getting as large a return as possible on the manufactured product. Assuming a good sales department that can dispose of articles at a fair price, it is seen that the economy in the raw materials and fabrication now enables the sales department to compete with other sellers, taking away the handicap of high cost. Of course, the articles do not sell automatically, so to speak; but the highly important human agency of sales manager, sales agents and traveling salesmen now take hold aided by economy in raw materials and fabrication and their own talents, quite well understood, together with some external agencies of sales economy.

The field of demand may be local, state, national, or world-wide, requiring adequate shipping facilities and storage at home and elsewhere. In local distribution, the evolution of horse trucking into automobile trucks, is becoming a great aid; as also for suburban and interurban shipments. An article in "Engineering News" of May 4th, 1911, describes the development of mechanical traction on roads in Great Britain (by L. A. Legros, M. I. M. E.). In state or nation wide and even foreign shipments the freight rates, continuity of transit and tariff enter the problem. The continuity of transit will exclude the northern water ways at certain periods; a stable as well as staple article, however, will overcome this handicap; the factory can keep on running, the goods can be stored until shipment can be made; the article is a staple and finds a ready sale. However, if the article is not a staple one, sales must follow manufacture quickly, and water rates, however low, are unavailable.

Articles destined for foreign countries with a fluctuating

or uncertain tariff, must be disposed of quickly. Reciprocity treaties now in force or pending will help overcome this in part. The quantities shipped at one time is an important factor in freight rates, large quantities making for economy in almost all ways.

It is thus shown in this short review how natural resources and the human element enter so deeply into successful, profitable, manufacturing, as to vitally affect the products of manufacture.

Industries, conditioned by natural resources, develop wholly through human agencies, and in order that the products of the forest, farm and mine may best supply our wants, there must be co-operation of workers, development of personality, insuring Economy in Manufacturing.

[NOTE—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

WATER POWER AND ITS RELATION TO IRRIGATION IN SOUTHERN IDAHO

BY JOHN C. BEEBE, C. E.

[Read before the Montana Society of Engineers, November 9, 1914].

Idaho is fast taking her place as one of the great irrigated states of the Union. The great area along the Snake River Plains of Southern Idaho, which a few years ago was a sage brush desert, cut by deep canyons, is now becoming settled, the long stretches cut by highways, and the sage brush driven out by alfalfa and fruit trees.

The greater part of Northern Idaho is blessed with an adequate amount of water for the crops, and at such places as there would be a drought under usual farming conditions, recourse is had to dry farming methods. Northern Idaho geographically, climatically and agriculturally is distinct from the arid plains to the south. Along the eastern boundary of the State, adjoining Montana, and the northern part adjoining Canada, the country is generally mountainous, and not susceptible to farming on a large scale. That part of the Palouse Country in Idaho, and the Camas Prairie near Grangeville have sufficient water for their crops, due to a great extent to the character of the soil. Near Lewiston there is some irrigation, but only on the comparatively low land near the river. Over the rest of Northern Idaho the agricultural land is in comparatively small units, where here and there a creek or river bottom spreads forming meadows or bars, or on the bottom of some prehistoric lake.

Between the agricultural land in the north, and the great plains of Southern Idaho there is a vast region of mountains cut by deep canyons, here and there dotted with beautiful lakes, and valuable only for grazing and timber and in a few places for mining. This strip of non-agricultural land is cut away at the eastern part of the State by the valleys of the north fork of the Snake River, and the streams tributary thereto, which are of sufficient width for agricultural purposes. In the western part it is cut away by the Payette and Boise Rivers, which due to their lower elevation and good water supplies have made valuable irrigated tracts.

Across the southern part of Idaho, in a westerly direction

flows the Snake River, which rises in the Yellowstone Park, and the mountains south thereof in Wyoming. From the Idaho-Oregon boundary line it flows north through a deep canyon to Lewiston, Idaho, where it turns west to join the Columbia. To the south of the Snake River Valley are mountains near the line between Idaho and Utah and Nevada, and to the north are the Salmon River Mountains. It is with a few of the irrigation projects in this valley that I wish to interest you.

It has only been during the past few years that the attention of the public has been called to the Snake River Plains as an irrigation possibility. Along the river bottom there have been for years small irrigated ranches, mostly the home ranches for sheep and cattle outfits. These ranches were irrigated by gravity from the springs along the rim rock of the canyon, or from the tributaries to the river. Owing to the height of the greater part of the irrigable land above the river bottom, it was no small man's proposition to undertake this irrigation, and vast capital had first to become interested before the larger irrigation projects could be undertaken.

Although there are a large number of irrigation projects in this territory—several large ones with an irrigable area of over 100,000 acres—I wish to confine this paper mostly to the peculiarities of these projects, particularly to those which raise water to the lands above the gravity canals by power derived from the Snake River and its tributaries, with a brief description of the power and pumping plants. These projects with which I wish to interest you are the Minnidoka Project, of the U. S. Reclamation Service, near Minnidoka, Idaho, the several irrigation projects in the Twin Falls District, near Twin Falls, Idaho, the Great Shoshone and Twin Falls Water Power Company, the Idaho Irrigation Company, Ltd., with, perhaps, a point of interest about some other projects.

It can be well understood that it would take volumes to describe all of these projects, but I wish here to describe only those particular points, or peculiarities of construction which would be of interest to the profession of Montana, with enough description of the different projects to give an idea of their extent.

The Minnidoka Project.

This is the first large project at the head of the Snake River plains, although there are several small ones, some undertaken by private capital, and some by Carey Land Act Companies. The acreage under this project is 118,700, seventy thousand of which is irrigated by gravity and 48,700 by pumping. The majority of the land on the north side of the river is under the gravity system, while that on the south side is under the pumps. The water for this project is taken from the Snake River, but on account of the large amount of prior appropriations it was necessary for the government to undertake a large storage proposition in order to increase the low water flow of the river.

The storage is accomplished by two reservoirs, Lake Walcott Reservoir, and Jackson Lake. Lake Walcott Reservoir is the storage formed by the diversion dam that diverts water into the two main canals of the project, and has an area of 11,250 acres and a storage of 53,000 acre-feet. This serves as a regulation and distribution point for the water stored in Jackson Lake. Jackson Lake is located in Wyoming, on the south fork of the Snake River, just south of the Yellowstone Park line, in what is known as the Jackson Hole country. This reservoir has an area of 22,500 acres, and a capacity of 380,000 acre-feet, which is sufficient to supply the demands of the Minnidoka Project during the driest of years of which there has been records. The main part of the dam at Jackson Lake is of earth fill, 2,850 feet long, 25



Fig. 1. Part of the spillway of Minnidoka Dam showing character of dam and the gates in the center distance. This picture was taken near the end of the rock fill dam.

feet high at its maximum point, 15 feet wide at top, with an 8-foot free-board, 3:1 slope on the water side, and 2:1 on the down-stream side. The control part consists of a concrete dam, 206 feet long, 28 feet above the stream bed, with twenty 5x8 foot radial gates. The stored water is passed here when the demand for it arises below, and is picked up at the Minnidoka Dam, and diverted into the canals.

The diversion dam, known as the Minnidoka Dam, which forms Lake Walcott Reservoir, consists of a spillway section, a rock-filled dam and a power house. The spillway section is about a mile in length, and is controlled throughout with flash-boards, in order that the maximum storage may be maintained, and still allow the passage of the flood flow of the river. There are also several tainter gates which may be used to increase the water passed at the dam. The rock fill dam is over the old river channel, and has a concrete core.

On account of the necessity of passing water for prior appropriators below throughout the year, at the time the dam was constructed in 1904 and 1905, the sluicing channel cut in the lava rock at the north end of the dam was filled by a structure that could later be made over into the foundations and side of a power house, with the splice gates as intakes for the wheels. The power house was constructed in 1908, and the first unit was put in operation in May, 1909. The power plant is the most modern and best equipped of any in this district. The equipment consists of five 1,400 kv-a., 3-phase, 60 cycle, vertical alternators, each direct connected to a 2,000 hp. turbine. Two 120 kw. exciters direct connected to small 180 hp. turbines are located at the northern end of the plant, adjoining the large units. The turbines are on the lowest floor of the building and take water from the upstream face of the dam. Below the power house a tailrace has been excavated for some distance, to the old river bed. The turbines are designed and operate under a 46 ft. head at 200 rpm. Their maximum efficiency is 81½ per cent, and their average efficiency between half and full gates is 77 per cent. The alternators, exciters, governors, and similar apparatus are located on the second floor. On the third floor are the switch boards, transformers, lightening arresters, oil switches, and bus bars. There are five air-cooled transformers delivering current at 33,000 volts. The electrical apparatus is con-

nected to duplicate 33,000 volt bus bars, and all synchronizing is done at 33,000 volts, and the wiring is so arranged that either transmission line can be carried on either bus.

The governors for the turbines are supplied from the central oil pressure system running through the entire length of the building. The oil is supplied by two geared pumps driven by direct current motors, with a brass pipe distributing line. The governors are provided with control from the switch board and is sufficiently accurate for synchronizing and dividing the load between the machines, and is so arranged that the operator can start or stop the machines from the switchboard. The gates at the intake are operated by means of controllers to facilitate the starting and stopping of any machine. The bearings for the vertical machines consist of a plain collar in oil, without pressure. These bearings are located at the top of the alternators, and the entire shaft is in tension.

The high tension lines and bus bars are in separate compartments, out of the way of danger to operators and anyone inside the plant. Two lines are run from the plant, one through Acquei, Rupert and Burley, and the other to the three large pumping plants, and then to Burley, and are so interconnected that any section can be cut out for necessary repairs.

Of the pumping plants on the south side of the river, plant No. 1 is the largest and takes water from the end of the south side main canal and raises it 31 ft. to the elevation of the intake of plant No. 2. Between No. 1 and No. 2 there is one lateral taking out which carries about 75 sec. ft. Plant No. 2 takes water from the first lift canal, and delivers into the second lift canal, 31 ft. higher. From the second lift canal about 175 sec. ft. are diverted by the H canal, and the remainder of the water flows to plant No. 3, where it is again raised 31 ft. to the J canal, which extends westerly past the town of Burley. These three plants are of the same general construction and design, but differ in size.

The current from the power plant is delivered direct to pumping plant No. 2, which is the distributing center for the current. In this plant are the transformers for plants No. 2 and No. 3, while the current is delivered at plant No. 1 at transmission voltage. All of the transformers are cooled by air blast, and receive current at 30,000 volts. Current is

delivered to all machines, and transmitted from plant No. 2 to No. 3 at 2,200 volts. In plant No. 1 there are four pumps of 125 sec. ft. capacity, and one of 75 sec. ft. capacity, operated by 600 and 360 hp. motors, respectively. The larger pumps are 48 in. in diameter, operating against a 31 ft. head, single stage, at 300 rpm. The impellers are 44 in. inclosed and the efficiency is about 77 per cent. The smaller pump is 36 in. in diameter, and has the same speed and efficiency as the larger pumps. Plant No. 2 has four of the 125 sec. ft. pumps, and plant No. 3 has two 125 sec. ft. capacity, and one of 75 sec. ft. These pumps are the same as those in plant No. 1.

These plants are so arranged with equal head that they will all work under equal efficiency. The pumps are installed in separate compartments, with a synchronous motor on the same shaft directly over them. The bearings for these units are thrust bearings, located on top of the motors, and instead of being of the type described for the turbines, these are of the roller type. These bearings have given entire satisfaction.

In order that the motors may be started as induction motors without load, there is a small pump which can be connected with any pit to drain the water. When the motor is running at synchronous speed, the gates of the forebay are opened by small motors, allowing the water to enter the pits. This method of starting has been discontinued, however, as the pumps themselves will empty their own pits.

The amount of water discharged by the pumps is controlled by cylinder gates, as in turbines. The pumps themselves are of the turbine type. From the pumps the water passes through five and one-half foot concrete pressure mains to the canal above. At the outlet of these mains are large flap valves made of $\frac{1}{4}$ in. boiler plate, which are so constructed and hinged that they insure a perfect fit, and do not allow water to flow back to the pump in case any unit is stopped. Small motors are used throughout the plants to run the exciters, the blowers for the transformers, the pumps for the oiling systems, and the small air compressors for cleaning apparatus.

During the past season bids were secured for runners of a different design that would increase the capacity per unit

from 125 sec. ft. to 150 sec. ft. Under operating conditions these runners have been found to furnish 180 sec. ft.

The Great Shoshone and Twin Falls Water Power Company.

Before discussing the pumping plants and projects in the Twin Falls country it might be well to describe the power plants of the Great Shoshone and Twin Falls Water Power Company. This company does a wholesale and retail power business in Southern Idaho, particularly in the Snake River Valley. They are at present operating two plants of their own, and have leased the Thousand Springs Power Plant. They also have other sites not yet developed. Each of these plants is of a different type, and deserves especial mention.

The Thousand Springs Plant.

This plant, which is leased by the Great Shoshone and Twin Falls Water Power Company, is doubtless one of the most unique in the world in respect to its source of water supply. A short distance below the rim-rock of the canyon there are numerous springs, flowing from a pervious layer of rock between two impervious layers. As to the origin of this water I do not know, but popular opinion says that it is the waters of the Big Lost River, and other streams, that flow from the mountains north of the lava belt into the lava and which there disappear. Some of it is doubtless due to the natural run-off of the lava belt which has no other means of flowing to the river. I do not know whether these springs have any seasonal variation or not, but from what I have been told the flow is fairly constant throughout the year. Throughout the length of the Snake River Canyon there are numerous springs, many of which are not located where they have a power value, but their total flow can be somewhat appreciated by consulting the hydrographs of the Snake River at Milner and Kings Hill. Much of the increase of flow between these points during the low water periods is due to the springs.

In order to connect several of these springs, tunnels have been bored into the rock to intercept the water, emptying into a concrete flume or canal running along the edge of the rim rock for a half mile or more towards the west, collecting more springs, and finally terminating at a spillway at the west end. Near the spillway are located the intake of two

30 in. pipes, which deliver the water to the wheels. At numerous points along the canal are located spillways to take care of the superfluous water. There is still a large amount of water that is not now used at the plants.

The plant itself is at the foot of the cliff on the Snake River bottom, is constructed of rock, and has a very pleasing external appearance. The developing machinery consists of two units. The water wheels are of the Pelton Francis type, operating under a 175 ft. head at 600 rpm. The generators are Westinghouse, 3 phase, 60 cycle, 1,250 kv-a., 2,300 volt. The exciters are belt connected to the generator end of the shaft. The switching is direct, and the transformers, lightning arresters, coils, etc., are all on the outside of the building. The transformers are water cooled, transforming from 2,300 volts delta to 44,000 volts delta.

The Shoshone Falls Plant.

The Shoshone Falls plant is the poorest designed plant of the three, from present ideals at least, and is located at one of the most spectacular water falls in the United States. At this point the Snake River has a series of cataracts amounting to about 188 ft., and furnishes an excellent opportunity for power. At present but a small part of the power is developed, but additional units will be installed as the demand for power arises. The flow of the Snake River at this point during the peak of the irrigation season is small, as compared with the flow for the rest of the year, on account of the large amount of water that is taken from the river above here for irrigation purposes. The normal flow is nearly all diverted into the two canals of the Minnidoka Project, and the two canals of the Twins Falls Projects at Milner, in addition to the water taken from the river for irrigation in the Idaho Falls Irrigation District, and the land above and about that district. In this way the low water flow, as well as the stored waters of Jackson Lake during dry years is all appropriated, and very little passes the Milner Dam during the latter part of the irrigation season. The flow at Shoshone Falls is much greater than that passing the Milner Dam due to the waste water returning to the river, and to the numerous springs in the canyon, similar to those at the Thousand Springs Development.

The water for this plant is diverted by a small dam, above the falls to a funnel, with suitable controlling works, through a penstock, to individual penstocks to the wheels. There are two units now in operation. One of these has been in operation for seven years, and has given entire satisfaction. This unit has a wheel made by the Platt Iron Works, properly designed for end thrust, with a General Electric generator, 2,000 volts, 360 rpm., 3 phase, with a belt connected exciter. The other unit has been in operation but three years and has given poor service. This wheel was furnished by another manufacturer, and the gates and runners have become so pitted that it is impossible to stop the wheel by closing the gates, and it has been necessary for the operator to improvise a brake to hold and stop the wheel while making repairs. The runners on this wheel have pitted so badly that it has been necessary to replace them twice.

It is expected at an early date to install a 5,000 kw. unit, in addition to the two they now have in operation. It is understood that the wheel is to be furnished by the Platt Iron Works, and that the electrical equipment will be furnished by the Allis Chalmers Company.

The units in this plant are run in synchronism with those in the Thousand Springs plant, and the Lower Salmon Falls plant. The current is transmitted at 44,000 volts, with the exception of that taken from this plant to the city of Twin Falls, which is transmitted at 22,000 volts.

Lower Salmon Falls Plant.

This plant is located at the Lower Salmon Falls of the Snake River below the Thousand Springs plant, and differs from the other two plants of this company by being a low head development. The ultimate plant, as designed is to have eleven units, two of which are now installed and in operation, and the plant is so constructed on the unit system that other units may be easily installed as the demand for power arises, until the capacity of the development is reached. The water is diverted by a dam across the Snake River above Lower Salmon Falls, into an open flume in which the wheels are placed, and from which the water passes directly under the plant into the river below. This open flume is divided between the units by gates, that may be closed to facilitate inspecting or repairing.

Trash racks are located at the upper end of the flume. The wheels are furnished by the S. Morgan Smith Company, of York, Pa. Thrust bearings are located on the wall between the wheel pit and generator rooms on the lower floor of the power house. These wheels operate under a 33 ft. head, which is reduced to 30 ft. in times of high water. The generators are on the same shafts as the wheels, and were furnished by the Westinghouse Company. They are 2,000 kv-a., 6,600 volt, 3 phase, 60 cycle, 200 rpm., with the exciters direct connected.

The control of this plant is strictly modern, of the remote system, with the switchboard of the desk type, and the instruments on pedestals. One board controls both machines and another the outgoing lines. All bus bars and wiring are in insulated compartments. There are six transformers in operation with one extra, all water cooled. There are two bus bars, one on each of the outgoing lines. On the second floor are the switchboards, transformers, and low tension busses. The high tension room is directly over the transformers, and contains the switches, high tension apparatus, choke coils, etc. The lightning arresters are placed on a platform on the outside of the building.

Twin Falls Projects.

The same capital that is interested in the Great Shoshone and Twin Falls Power Company also is interested in the largest irrigated acreage in the State made up of several segregations, and directly controlled by several operating companies. These operating companies, and the segregations under each are:

Twin Falls Land and Water Co.....	214,056
Twin Falls North Side Land and Water Co.....	244,004
Twin Falls-Oakley Land and Water Co.....	45,000
Twin Falls-Salmon River Land and Water Co.....	127,707
West End Twin Falls Irrigation Co.....	46,116

Besides this acreage, the same companies or allied companies, have had several hundred thousand acres segregated, and which are, I believe, still withheld under present or future irrigation systems. In all, this system contains much of the best land in Southern Idaho.

Twin Falls Land and Water Company.

This project was the first Caret Land Act Project in Idaho, and in 1910 was transferred to the Water Users' Association. This land is under a gravity canal from the Snake River taken out at Milner Dam, at the upper end of the Snake River Canyon, and follows the edge of the segregation. The High Line Pumping Company, Ltd., has taken over 5,000 acres of land under this segregation, and is pumping water to land above the gravity canal, from the high line canal of the Twin Falls Land and Water Company. This part of the project has also been turned over to the settlers for operation. The main pumping plant consists of five units. Three 15 in. pumps, direct connected to 100 hp. motors raise water 38 ft. above the canal and two 8 in. pumps, direct connected to 50 hp. motors raise water $67\frac{1}{2}$ ft. to a higher canal. There is also an auxiliary plant, taking water from the 38 ft. level, and pumping it 33 ft. higher, using two six inch pumps, direct connected to 20 hp. motors. The tested efficiency of the pumps was 73.6 for the 15 in., 70.0 for the 8 in., and 68.8 for the 6 in. pumps.

Twin Falls North Side Land and Water Company.

The land under this segregation is on the north side of the Snake River. The water is diverted at the Milner Dam, the same dam that diverts the water for the Twin Falls Land and Water Company. To augment the normal and low water flow of the Snake River, this company has two storage reservoirs under the canal, known as the Wilson Lake Reservoir, and Jerome Reservoir. Flood waters from the Snake River are diverted to these by the main canal, and later in the season, when the supply in the river is low, water is drawn from these for the irrigation of the land under them.

Much trouble has been experienced with the Jerome Reservoir, though at the present time it is thought the trouble has been eliminated. The reservoir is on a lava rock, and the fissured and broken surface allowed immense amount of seepage. Several methods were tried in an effort to stop this seepage; first by removing all of the sage brush and roots that would decay and allow water to flow through to the fissures; then the bottom was dragged, and later puddled. Finally a part of it was concreted.

Under this project there are five pumping plants, taking

water from the gravity canals and delivering it to land that is too high for the gravity canals. Below I copy from the State Engineer's report, for 1912, giving the plants, capacity of the pumps, and efficiency as determined by the State Engineer's office. I believe the efficiency referred to is the efficiency of the pump alone:

"Pumping Plant No. 1—Three 15 in. R. D. Wood & Co., double suction centrifugal pumps with a rated capacity of 12.61 sec. ft. each; three 100 hp. 2,200 volt 870 rpm. Westinghouse motors; total head, 50.12 ft.; efficiency of pump as shown by test, 74.3 per cent." (This plant is northwest of Milner and irrigates 3,000 acres.)

"Pumping Plant No. 2—Four 15 in. R. D. Wood & Co., double suction centrifugal pumps, with a rated capacity of 13.33 sec. ft. each; four 150 hp. motors, 2,200 volt, 860 rpm.; total head, 66.9 ft.; efficiency of plant as shown by test, 77.3 per cent." (This plant is northeast of Milner, and pumps water from the Snake River above the Milner Dam. It irrigates about 4,300 acres.)

"Skeleton Butte Pumping Plant No. 3—Three 12 in. R. D. Wood & Co. double suction centrifugal pumps with a rated capacity of 9.78 sec. ft. each; three 75 hp., 2,200 volt, 870 rpm. motors (Westinghouse); total head, 41.06 ft.; efficiency of plant as shown by test, 71.9 per cent." (This plant is west of Milner, and irrigates some 2,270 acres.)

"Big Sugar Loaf Pumping Plant No. 4—Low lift—Three 16 in. R. D. Wood & Co. double suction centrifugal pumps, capacity 18 sec. ft. each; three 150 hp., 2,200 volt Westinghouse motors; approximately 49 ft. head; plant not as yet tested for efficiency. High lift—Three 12 in. R. D. Wood & Co. double suction centrifugal pumps, capacity 11 sec. ft.; three 175 hp., 2,200 volt Westinghouse motors; approximate head 98 ft; plant not as yet tested for efficiency." (This plant is to irrigate about 7,000 acres.)

"Little Sugar Loaf Pumping Plant No. 5—Three 10 in. Worthington double suction centrifugal pumps,

rated capacity 6.67 sec. ft.; three 50 hp. 2,200 volt, 860 rpm. motors; total head 45.7 ft.; efficiency or plant as shown by test, 71.6 per cent." (This plant irrigates 1,700 acres.)"

The power for all of the above plants is obtained from the Great Shoshone and Twin Falls Water Power Company.

Twin Falls-Oakley Land and Water Company.

This project located on the south side of the Snake River is a storage proposition, using the stored waters of Goose Creek. Seventy-four thousand acre-feet of water are impounded by an earth dam about 145 ft. high near Oakley, Idaho, with the controlling works located in a high concrete tower reached from the crest of the dam by means of a bridge.

Twin Falls-Salmon River Land and Water Company.

This project is also on the south side of the Snake River, adjacent to the land of the Twin Falls Land and Water Company, and to the west. This project depends on the stored waters of Salmon Falls River. 180,000 acre-feet are impounded

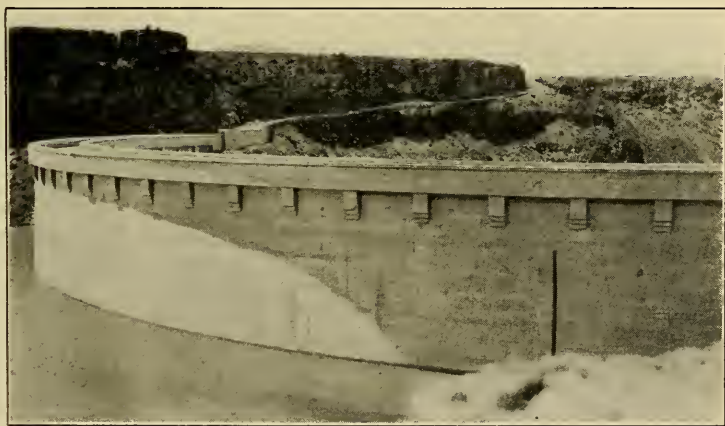


Fig. 2. . The Salmon River Dam from above, showing the roadway on top of the dam.

by a concrete arch dam, 220 ft. high. The control works are located in a tunnel in solid rock, by which the water is taken from the impounding reservoir to the canal below. The machinery to operate the gates is located in a house on the surface of the ground over the tunnel.

West End Twin Falls Irrigation Company.

This project is a continuation of that of the Twin Falls North Side Land and Water Company, taking water from the latter company's canals, and delivering it to land west of the latter's segregation.

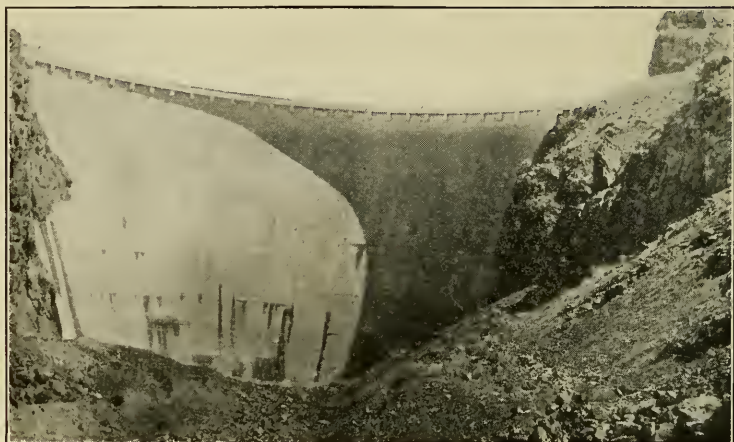


Fig. 3. Salmon River Dam from below. This is the impounding dam of the Twin Falls-Salmon River Land and Water Co. and is about 220 feet high.

Idaho Irrigation Company, Limited.

This company has a segregation north of the Twin Falls North Side Land and Water Company's, consisting of about 130,000 acres, watered from the normal flow of the Little Wood River and the normal and stored flood flow of the Big Wood River. The flood flows of the Big Wood River are stored by means of an earth dam approximately 140 ft. high, and capable of impounding 200,000 acre-feet. The control works consist of two 60 in. valves operated by hand in a concrete tower over the entrance to a tunnel through solid rock at one end of the dam. The spillway is located at one end of the dam and diverts water over solid rock back into the canyon.

It is now proposed to irrigate several thousand acres of additional land above the gravity canals by developing power at drops in some of the canals, and near the canyon of the Big Wood River, sufficient for about 15,000 h.p. during the

irrigation season, and about 1,000 h.p. during the winter and none during irrigation season, for the use of the towns on the project that do not have light from the Snake River Power Plants. Final plans have not as yet been made, but it is expected that at least a part of the pumping system will be completed in a few years.

Following I have appended three tables, giving a partial list of the irrigation projects in the Snake River Plains, the storage propositions that go with these projects, and a table of irrigation statistics from the State Engineer's report for 1912.

These are, I believe, the most interesting power plants and irrigation systems in the southern part of the State. I appreciate that I have not covered any of these projects with any detail, but have tried to describe those points that were of interest to myself when making a trip about the projects, with the hope that the same points might be of interest to others. There are also other projects and power developments in southern Idaho which would be of interest, but I have tried to confine myself to a rather small area, as a description of systems outside of this area, even in southern Idaho, would make a long and doubtless tedious paper.

I am very sorry that it is impossible for me to present this paper in person, for I would be glad to take part in any discussion that may arise, but I feel well satisfied in leaving the paper in the hands of the secretary.

Table No. 1.

PARTIAL LIST OF IRRIGATION PROJECTS IN SOUTHERN IDAHO.

Project.	Segregation.	Water Supply.
Minnidoka, U. S. R. S.....	118,700	Snake, stored.
Twin Falls North Side Land and Water Co.....	244,000	Snake, normal.
		Snake, stored.
American Falls Canal and Power Co.....	57,241	Snake, normal.
High Line Pumping Co., Ltd.....	5,000	Snake, normal.
Twin Falls Land and Water Co.....	214,000	Snake, normal.
Twin Falls-Oakley Land and Water Co.....	45,000	Goose Creek, stored.
Twin Falls-Salmon River Land and Water Co...	128,000	Salmon Falls River, stored.
West End Twin Falls.....	46,000	Snake River, normal, stored
Idaho Irrigation Co., Ltd.....	128,000	Little Wood, normal.
		Big Wood, normal, stored

Table No. 2.

PARTIAL LIST OF STORAGE PROPOSITIONS IN SOUTHERN IDAHO.

Project—	Dam.	Material.	Height.	Capacity.	Stream.
Minnidoka.....	Jackson Lake	Earth	25 ft.	338,000	Snake.
Minnidoka.....	Lake Walcott	Concrete, earth	55 ft.	53,000	Snake.
Twin Falls, N. Side					
	Wilson Reservoir	Masonry		20,000	Canal.
	Jerome Reservoir	Earth		150,000	Canal.
Oakley.....	Goose Creek	Earth	145 ft.	74,000	Goose Cr.
Salmon River....	Salmon River	Concrete	220 ft.	180,000	Salmon.
I. I. Co.....	Magic Dam	Earth	140 ft.	200,000	Big Wood.

Table No. 3.

IRRIGATION STATISTICS, 1912.

(State Engineer's Report, State of Idaho, 1912.)

County	Miles of Canal.	Cost of construc- tion.	Acres under canal.	Acres cultivated.	Acres unculti- vated.
Ada	1,354	\$7,835,540	342,760	138,368	204,392
Bannock	314	437,765	60,076	35,580	24,496
Bear Lake	320	175,352	39,605	28,365	11,240
Bingham and Booneville....	1,955	2,727,840	456,200	326,380	129,820
Blaine	605	906,030	124,915	76,220	48,695
Boise	174	82,750	28,765	9,830	18,935
Canyon	1,041	2,259,675	182,320	137,535	44,785
Cassia	364	3,555,620	152,250	77,905	74,345
Custer	257	106,390	75,230	57,250	17,980
Elmore	193	647,375	50,480	8,570	41,910
Fremont	1,664	1,358,105	426,340	238,235	188,105
Lemhi	159	60,000	39,610	16,350	23,260
Lincoln	1,423	9,507,200	480,900	214,250	266,650
Oneida	365	1,153,200	80,170	43,800	36,370
Owyhee	325	2,325,995	91,760	33,270	58,490
Twin Falls	1,121	4,223,090	404,995	166,555	238,440
Washington	250	1,754,360	79,136	25,467	53,669
Totals—					
Miles of Canal					11,884
Cost of Construction					\$39,341,285
Acres under canals					3,153,512
Acres cultivated					1,647,430
Acres uncultivated					1,506,082

[NOTE—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

THE ECONOMIC SIDE OF CITY PLANNING

BY HENRY WRIGHT,*

[Read before the Engineers' Club of St. Louis, Jan. 6, 1915.]

Recognizing the importance and scope of your organization, I should be greatly pleased to be able to lead you to an appreciation of the immediate importance of applying to our city at this time those methods of study and civic advancement which have been grouped under the general name of City Planning. Should I be successful to impart to you something of my own enthusiasm in this matter, I am quite sure that it will lead you to place city planning as the matter of first importance on your programme for the present year.

We are beginning to realize that collectively, the City has a mind, a conscience, but we are still at a loss to get at this collective mind in such a way as to make our cities really fulfill their broader functions. There are many encouraging signs, such as the successful formation of clubs for the daily discussion of city topics, and such movements as our own recent Pageant, etc., all of which are for the purpose of getting us together, so that we may better understand each other and provide a channel for mutual expression and discussion of matters of public betterment.

Now it would seem especially appropriate and desirable for the men of this Club to place themselves in an attitude toward these questions such as that expressed by the City Planning movement. There are many technical phases of City development and efficiency which the lay mind does not readily grasp, but which you as engineers will appreciate and be able to apply effectively.

City planning is not merely a comprehensive plan for physical development of the city, but is a plan also in the sense of being a programme, a business policy for meeting our city problems in a rational way. It depends for its final success, not upon spasmodic popular adoption of individual ideas which may be carried over upon the crest of a wave of

*Landscape Architect.

civic enthusiasm, but molds the civic mind to an appreciative attitude of doing things not only in a large way, but with due proportion as warranted by their relative importance and necessity. It recognizes the mutual loss of doing things disconnectedly and the mutual acceleration gained by bringing them into co-ordination.

City planning in its operation has three progressive functions: (1) Correcting situations caused by faulty and inadequate planning; (2) Regulating and preventing recurrences of bad planning; (3) Using the city forces in taking the initiative, in blazing the way for private investment.

The general science of city planning in this broader field of operation has been a matter of recent development and has grown out of a realization in those cities which have done the most creditable and extensive things along the lines of one or another phase of city development, that there has been continually a loss in every piecemeal attempt at city improvement. Those cities which have made the most remarkable advances along certain individual lines are now beginning to question how to better proportion city development among all its activities. For instance, Philadelphia, while not showing any one very prominent line of civic activity, has developed along many lines and has gained greatly in general civic experience, and yet in reporting upon a recent comprehensive study of the transit situation which was to be a further development of a very good system already largely controlled by the city, the City Parks Association makes the following comment:

"It is a satisfaction to record that it (the Rapid Transit Report) is by far the most comprehensive study of the existing transportation situation and the general needs for the future extensions of Rapid Transit facilities that Philadelphia has ever had."

However, in just a few paragraphs following, this is qualified by the admission:

"No adequate solution of the Transportation Problems can be reached except by a City Planning study made from all points of view of that subject."

It is interesting to note that this study proposed alterations costing about \$34,000,000, which it was estimated

would save for two-thirds the population of Philadelphia from one to fifteen minutes each day.

Fundamental Problems in City Planning.

May I attempt to point out some of the more apparent problems of the present time in our city, suggesting both the problem and its correction in a fundamental rather than a detailed manner? To show that I can qualify as an engineer myself, I shall resort to pencil, or rather chalk, to illustrate and supplement my thoughts.

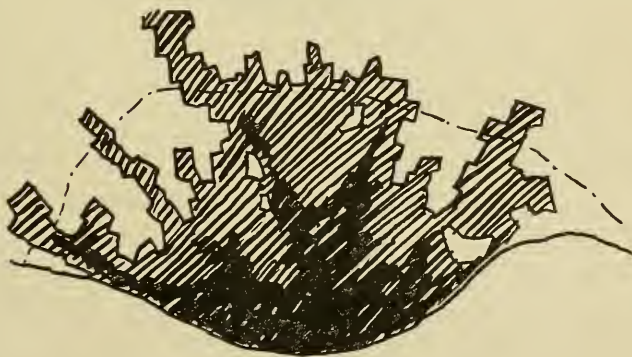
The City Limits.

After gradually extending the limits of the original community which occupied what is now our business center and

FIGURE I.



The Artificial City Boundary.



The Actual City Boundary

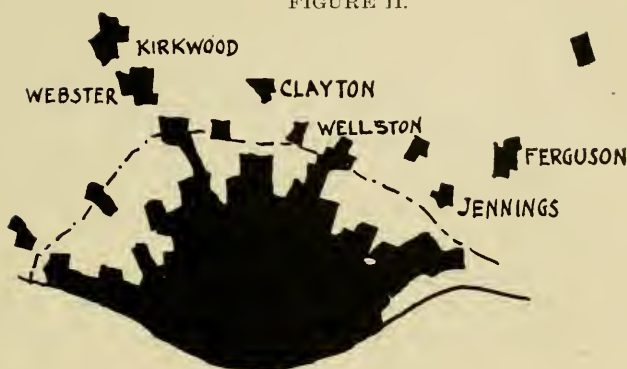
taking in various communities along the river front, it was decided in 1876 to extend the border line of the city to the furthest extremity of what then seemed to be within the

bounds of possibility of future growth. This extension corresponds with the present line separating St. Louis from St. Louis County. Of the general space thus comprised we have to be sure only made a partial use, leaving great vacancies to the southwest and northwest, while at many other points we have now extended far out beyond our boundary. (See Fig. 1.) One of the matters of first importance in city planning is to both plan and encourage the use of these larger vacant territories lying within our artificial boundary, as well as the many smaller and local open spaces which have been left in the course of the city expansion, due often to their low elevation, or inaccessibility, and frequently made a dumping ground for the surrounding neighborhood. There is a self-evident opportunity for great economy in all measures which will help to fill in these open spots rather than carry beyond them all of the additional lengths of highways and utilities thereby requiring fire and police protection and lighting, over uselessly large areas. To clean up such waste places and to make them both more desirable and accessible, is the first important principle of city economics.

The Border City.

Before leaving the matter of the city boundary, let me also call attention to the present problem of the border city which is unusually acute in St. Louis County, since we can only with the greatest difficulty arrange for the extension of its limits, while St. Louis is already spilling over its boundary and a large portion of the present building activity of the community, outside of the business center, is occurring in this area both within and without the city line. Ten years ago our maps showed a real distinction between city on the one hand and suburban communities scattered throughout the nearer portions of the County. Now it has all run together so that no such line is distinguishable, except in the more remote instances. (See Fig. II.) In this adjacent territory we have now one third class and five fourth class cities occupying irregular tracts with County areas interlaced between them in a heterogeneous manner. It is not an unusual thing to find a community of apparently closely related interests, lying partly within the city of St. Louis, partly in an incor-

FIGURE II.



Suburbs Ten Years Ago.



Suburbs To-day.

porated County city, and partly in just plain County. It would seem a very desirable matter from every standpoint that all of these communities should be co-ordinated together under a general plan of expansion which will not only properly distribute the territory among the different incorporations, but also get them working together along all lines of general improvement in which they should be jointly interested.

There is an act which has both been passed by the Legislature of Pennsylvania and is now in operation there which provides a metropolitan planning commission for an area within 25 miles of a city of the first class, and which also provides that cities of the second and the third class may plan for territory extending from three to five miles beyond their limits and that even previous to extending those limits, the

surrounding communities cannot make improvements which would interfere with the future carrying out of such plans. All of this merely recognizes the general principle that the territory which lies around a city secures advantages, especially advances in value, from that city, and in return must either prepare or permit itself to be prepared for those improvements which will best suit this territory for the future expansion of the city.

We have already taken a step in the right direction in our plans for an outer parkway system and this movement should be expanded into a general suburban planning movement.

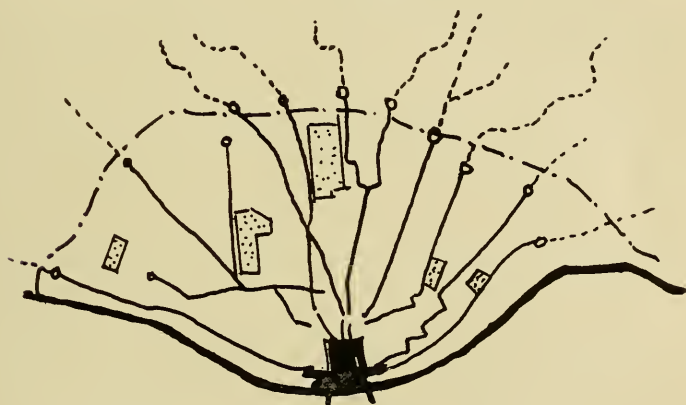
Transportation Problem.

It is surprising to find how interlocked with every other problem is this matter of transportation. It is affected by the same defects in interior street planning which are bringing about our traffic congestion. We are all familiar with the defects of our transportation system, so much so that we begin to take them as a matter of course. However, the general radial plan of our city in which transportation from every outlying section can be brought in almost independently, makes our problem one of comparative simplicity. In Chicago, for instance, not only must the business center be reached by the transportation lines, but they must also haul through the business center practically all of the cross-town traffic. Many other cities are similarly situated. Here there is no necessity of bringing to the center of the city any traffic which is foreign to it, nor of any large concentration of traffic, except as caused by local defects in plan which can be corrected without resorting to very radical alterations. The down town transportation solution seems to consist chiefly in unscrambling the eggs. Without assuming to know just how or in what manner correction should be made, we may merely cite the self-evident losses in time and increase of traffic interference by the interlacing of car lines originating in the same general territory and crossing each other at four different points as in the case of the Wellston and Hodiamont lines and at two different points for both the Hodiamont and Page, and the Hodiamont and Olive lines. Nor can there be any justification for the interference of the radial Page line with the main cross-town line on Grand avenue for a distance of

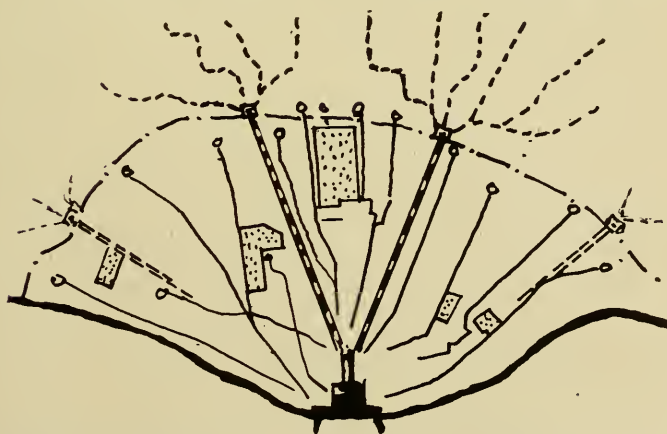
five or six blocks along the narrowest portion of the latter thoroughfare.

But after all, the fundamental transportation problem of the city is not so much one of downtown interference which can be corrected, as it is a failure to separate short and long haul passengers. (See Fig. III.) The continuous extension of car lines for which our real estate men are always clamoring is not a rational solution of the traffic problem. Such extension is one of the most potent factors in the instability of residential property. We are always moving out to the end of the line. We may leave our neighborhood to-day to

FIGURE III.



The continued extension of local car lines is illogical.



By gathering suburban cars into express trunk lines, local cars are restored to legitimate use.

get away from crowded cars and it will only be a few years until our neighbors have not only followed us, but have gone beyond us, and it is our turn to move again. In building an office building you recognize the facts that in a ten-story building a given number of general elevators perform the service, but in a 25-story building, we separate our service into some which are local, for the lower floors, and others for those above. Applying the same principle to transportation, instead of first filling our cars at the border of the city and then attempting to pick up all the local traffic over the eight or ten miles which intervene to the business center, we must select certain lines or add others, which shall form trunk lines to proper distributing points for long haul passengers. In doing this we will not only better serve those traveling from our suburbs, but will restore to their proper local function all of the other lines of our car system which were originally intended for local transportation—and can readily serve in an adequate manner all of the territory lying within a reasonable distance.

I am inclined to think in our community to-day, the transportation problem might be adequately solved without any additional lines and with only a limited amount of subway or other radical change, but in all such problems the difficulties are not so much physical as they are administrative and legal. I have no doubt that our transportation interests recognize the need and easy possibility of many changes which would be desirable to the public and which would be actual economy in operation expenses. However, we have not yet learned just how to get together to do the most obvious things, and instead remain at swords' points over matters of mutual desirability.

In this connection I wish to state my general conclusion, based upon a careful study of the City Plan, that none of our practical problems, either transportation, traffic or any other involving lines of communication, can be solved in this city by one central stem. While on the one hand a very large proportion of the volume of passage to and from the business center is carried on within the central section of the radial fan of our city, it is distinctly divided into two main lines of communication, or at least main districts of communication—one running southwest, and the other slightly north

of west. Between these two main arteries lies Forest Park and portions of the city occupied by private places and individual homes, all of which give rise to a comparatively small amount of traffic, and any attempt to force out through this central division a single subway or a single traffic artery, is merely adding to our complications without effectually and efficiently solving our problems. In other words, our city is decidedly a bi-ped, or rather a quadruped when we take into account as well those important arteries of direct north and south communication which must also be included in our city plan.

The Problem of Traffic Congestion.

But in the solution of traffic problems we must not overlook the fact that heavy traffic will always follow the lines of easiest grades, such as those found along Manchester road and Market street, on the south, and, if made more accessible, Easton and Page on the north, and that general traffic relief is secured by keeping the various lines of traffic moving upon their shortest course into the center of the city, with the least amount of unnecessary interlacing and crossing over, both of vehicles and transportation lines.

The first application of the above principles suggested is in the case of the large amount of traffic which centers in Delmar boulevard—the only through avenue for a large section lying west of Kingshighway. At this latter point, traffic is broken up and disseminated by reason of the car line interference and narrowing of the street over a few blocks between Kingshighway and Taylor, east of which we find the widest available street in the west end, practically unused at the present time. (See Fig. IV.) The reason for this is also to be found in the unfortunate interference of the Page cars at Grand avenue, in the jog in the street and the lack of available street connection eastward, to a point immediately in line with Delmar,—only a few blocks away,—at Jefferson avenue,—where we find Washington avenue a wide thoroughfare but little used. Add to this the fact that at least for the present the principal destination of traffic in the business section, including that of the large merchandise houses and the commission houses have a center of gravity that is almost as far north as Washington avenue, and we are at once forced

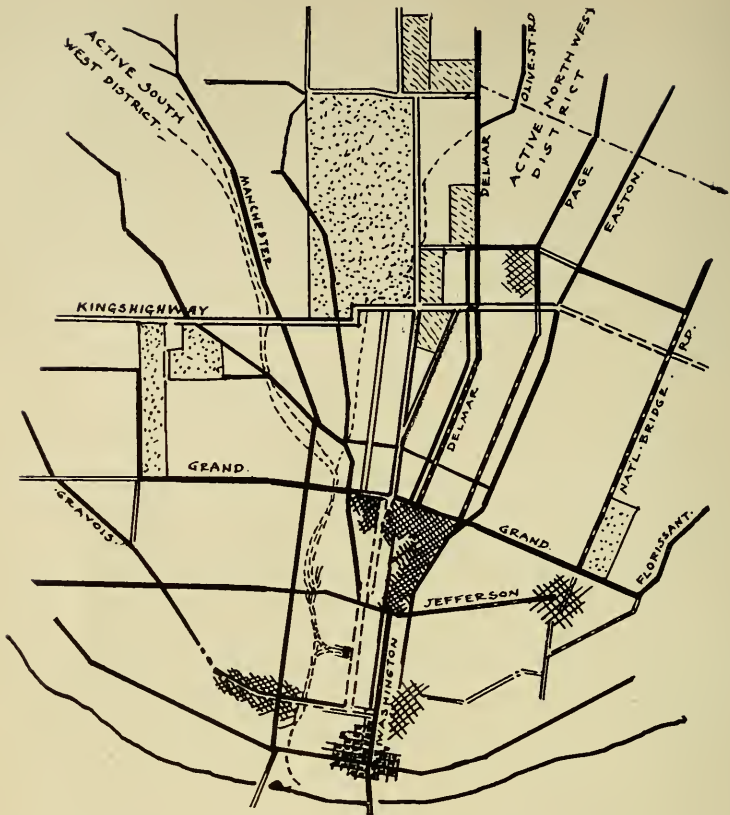


Fig. 4. Map of existing traffic situation (showing friction zones by hachures) which prevent the full use of logical traffic arteries and reduce the city's efficiency.

to the conclusion that this important phase of our traffic movement cannot be best served either for its own good or to the general advantage of the city by leaving the matter of traffic relief to street widening three or four blocks south of, and out of line with this need.

Residential Stability.

One of the most important problems in this city is to curb the continuous change and instability in the value of residential property. I have already pointed out that one factor in causing this unrest is the tendency to continuously move outward in an endeavor to secure better car service. Of course, we cannot overlook the conditions brought about by

the complete building up of the district, accompanied by the increase of smoke nuisance which leads home dwellers to move to new districts failing as they often do, to realize that the same conditions will there repeat themselves in a comparatively short period of time. Such tendencies are not necessarily objectionable and need not be discouraged, but one additional main factor in causing residential instability lies in the fact that to provide a good pavement on a residential street parallel to main lines of traffic, practically amounts to an invitation to the use of this street as a trafficway. This is augmented by the fact that the main and logical lines of commercial traffic are often not properly carried through to their destination, so that residential streets become used in their stead, finally causing an abandonment of the commercial street and the gradual commercializing of residential streets.

You will pardon me in again using Delmar as an example, which I do on account of my greater familiarity with both the history and the conditions in this section. (See Fig. V.) The failure to provide logical connections for Delmar east of Kingshighway, and especially at Grand avenue, has forced the use of adjoining streets on the south, causing an influx of both private vehicle and commercial traffic which is an important factor in the marked deterioration of residential values in this section, all of which has come about in a comparatively short time. Not only does this result in detriment to the private owner, but the jogging over of traffic movement in this way at Union, Kingshighway, and elsewhere, is a factor in traffic interference producing both congestion and accidents. For instance, traffic southward on Kingshighway, crossing Delmar, which shows a traffic movement equal to that at Grand and Lindell, largely turns into Washington avenue eastward, thus crossing the important Delmar car line at two different points in a space of less than five blocks. (See Fig. V.) The treatment of Delmar as a main artery by different routing for the carline east of Kingshighway where the street narrows from 100 to 80 feet, and proper continuation east of Grand, would not only have avoided the invasion of good residential streets, but traffic interference and loss in time for the entire central west section. Similar cases can be found in every part of the city.

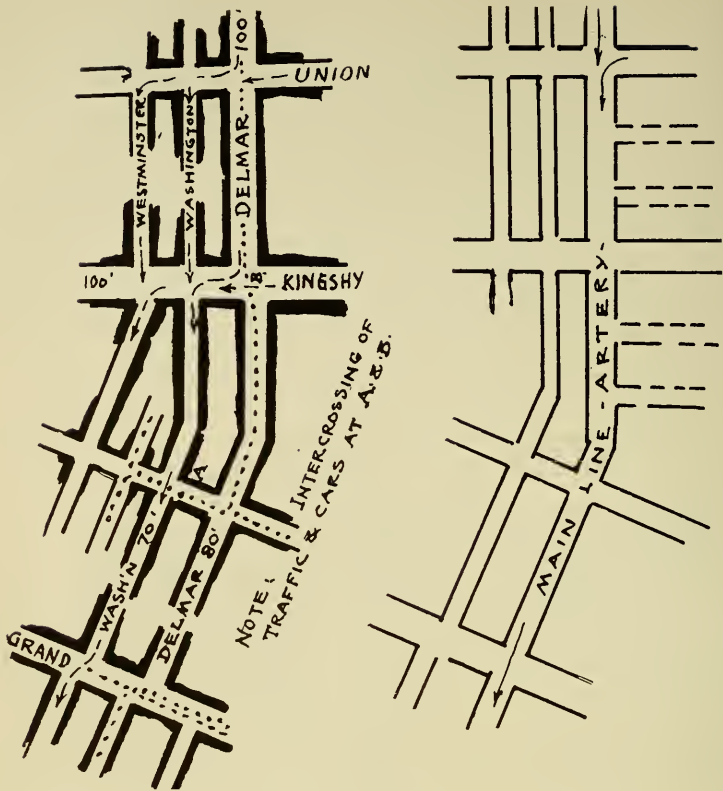


Fig. 5. By failure to connect main arteries residential streets are invaded, causing instability of private investment.

By providing direct commercial arteries, residential privacy is preserved, especially when minor streets run at right angles to main traffic movement.

The Parkway.

On the other hand, a centralized avenue of communication for lighter traffic, especially one which adds dignity and beauty to the city, such as that proposed in our Central Parkway, can be substantiated and made both reasonable and convincingly desirable on its own merits as such without attempting to add to its attributes of doubtful value as an important factor in the general traffic problem of the city. There is no doubt that it will have both a temporary beneficial effect upon traffic movement and will permanently prove some value, especially in the movement of light traffic to the central west end and beyond, which can be increased by providing connec-

tions at the western end of those streets which lead directly into it.

While perhaps taking away for a moment from the Parkway some value with which you may have been asked to endow it, I wish to express my very thorough approval and hearty support of this undertaking. Not only will it clean out a portion of the blighted neighborhood through which it passes, which has existed most unfortunately at the very gateway of the city, but it should have a marked effect in stimulating the entire renovation of this section. While there are many important problems involved in such a restoration, I may only stop to say here that this is an excellent example of the third principle of city planning in which the city must take the initiative in blazing the way for new investment and also the return of investment into districts which have been left stranded by the expansion and alterations of the city. It is not difficult to conceive those interests which can be looked to to occupy the eastern section of the parkway, especially that lying between the business section and the Union Station. The western section has been a more difficult question in my mind, but I was quite interested only in the last few days, in reading in one of the popular architectural journals an article calling attention to what it calls "Back to the Centre of the City" movement, which I quote:

"Concurrently with the well recognized 'back to the country' movement, there is also a movement in the opposite direction that sometimes escapes notice, a 'back to the centre of the city' movement that leads people to seek dwelling places now where a few years ago they would not have thought for a moment of looking. Apartments and flats are not to their taste and yet, oftentimes, their means are not sufficient to warrant the purchase or upkeep of a large house on one of the fashionable residential streets. Consequently they must needs turn their attention to the intensive use of space and look to the architectural reclamation of the unimproved areas in small back streets for the one feasible and satisfactory solution of the problem that confronts them."

If we can solve the transportation problem, so as to restore the city car lines and can successfully pursue our intention to relieve the city of the smoke nuisance, there is no reason why the present blighted district between Jefferson and

Grand should not in portions, especially around the parkway, become the destination of our Back to the City movement. Add to this the fine buildings which should constitute our social centre at the western terminus of the parkway, and we have encouragement not only for the parkway itself but for its greater importance in the general problem of city development.

True City Economy.

I have perhaps left you too long in doubt as to this matter of city planning as an economical measure, and I wish to relieve you at once from any expectation of my recommending a withdrawal or suppression of wisely chosen improvements which may call for a large expenditure of the city's funds and the reduction of our present credit upon our available bonded indebtedness.

The economy which can be attributed to my subject is that which arises from well thought out and orderly improvement, conservation of our facilities, in the first place, but primarily in looking forward and realizing in advance those situations which will later lead to congestion or other disturbances which would then have to be relieved at a cost many times greater than that which would be the case at this time. We can find in almost any of the larger cities unfortunate conditions the correction of which has already been, or is rapidly being, enforced upon them, entailing enormous cost, and it will probably be found that those cities which have had to most largely draw upon their bonded ability are doing so for the purpose of meeting these very matters caused by lack of intelligent and timely city planning. The fact that our city has been so fortunate as to have its resources carefully guarded and conserved, is merely an added encouragement to the city in realizing its ability to quickly undertake every reasonable means of making the city better and less subject to future drain upon its resources.

While there are many other problems of city planning upon which I would like to touch, I will merely sum up by saying that with city planning we will be able to find new ways of better applying the public funds and making use of the public equipment in taking the initiative in directing the expansion and filling out the activities of the city. It will

cause the city to be made more convenient, more cohesive and permanent; it will establish new values and new uses for waste areas otherwise left in the wake of advancement; it will cause the city to take its place as the leader and not the follower in all matters involving new investment and enterprise. Only by so doing can the city hope to properly control and influence those developments which will finally lead to an orderly, substantial and beautiful city.

May I also mention that there is a movement on foot which has already been endorsed by a number of civic organizations, to have a city planning exhibit in this city in the early spring, and the idea has just come into the plan that this should be in the nature of a greater St. Louis City planning exhibit applying not only to ourselves but to all of our neighbors. I should be very pleased if this Club feels sufficiently interested in the subject that when the opportunity is presented, they will, collectively and individually, lend a hand to this movement which is just a step toward the common end of making St. Louis a better, more convenient and more efficient city.

[NOTE—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

REINFORCED CONCRETE COLUMN FORMULAE

BY CARL GAYLER, HANS C. TOENSFELDT, AND CHARLES W. MARTIN.

[A special committee of the Engineers' Club of St. Louis.]

To the Members of the Eng. Club of St. Louis, Mo.

Gentlemen:

After considerable study of the results of recent tests on reinforced concrete columns your committee, appointed to investigate the status of the regulations for the design of such members under the present St. Louis Building Code begs leave to report:

(1) Under the present Code an abstract of which is attached—the relative values of unit elements considered as providing composite working resistance in the two general types of reinforced concrete columns may be expressed, essentially, as follows:

(a) In columns other than hooped columns each square inch section of longitudinal bars, either of medium or high elastic limit steel, in the column section is assumed to provide an increment of resistance equivalent to resistance of 15 additional square inches of concrete.

(b) In hooped columns each square inch section of longitudinal bars in the column section is assumed to provide an increment of resistance equivalent to the resistance of 28 additional sq. in. of concrete if medium steel is used, of 40 additional sq. in. of concrete if high elastic limit steel is used and also the hooping metal is considered equivalent to the resistance increment thus provided by a volume of metal 2.4 times greater and disposed in imaginary longitudinals.

(c) Calculation of the maximum composite safe working resistance of either of the two types of columns is to be made upon a basis of 500 pounds per sq. in. on the considered effective concrete section.

(2) Your committee finds no general objection to that portion of the Code dealing with columns other than hooped columns but finds that portion dealing with hooped columns objectionable upon the following counts:

(a) That only at column loadings approaching the ulti-

mate can the relative efficiency of elements considered as providing resistance obtain.

(b) That a column loadings safely below the yield point the efficiency of high elastic limit steel reinforcement is no greater than reinforcement of medium steel.

(c) That the Code encourages the use of hooping as is well, but does not limit the amount thereof to be considered in proportioning columns.

(d) That for columns of small section the specified pitch of hooping is too small to allow proper flow of concrete in its placing.

Your committee recognizes the fact that this portion of the Code has been of good service. It has encouraged concrete construction. No serious failures have occurred. The large premium placed on hooping by the Code is, however, considered a hazard by your committee in that the amount thereof to be so figured is unlimited. Increased competition in the concrete construction business may cause larger and larger proportions of hooping metal to be used with the result that reasonably safe factors against initial failure—cracking of the outside shell—will not obtain. The first appended graph shows that while hooping does augment a column's ultimate strength in about the ratio given in the Code its effectiveness as regards initial failure is practically nil. This graph illustrates the results of tests of hooped columns made by the University of Wisconsin.

(3) For these reasons your committee recommends to substitute for certain portions of section 202 of the Building Ordinance of the City of St. Louis under the heading, "Reinforcement in Columns" and "Hooped Columns" the following rules, in which a unit section of longitudinal steel is considered 15 times as effective as a unit section of concrete and in which a fixed percentage of hooping is specified for hooped columns and the efficiency thereof taken into account by the allowance of 50 per cent higher stress in the concrete. Other changes relative to the fabrication of column reinforcement are also included in the following:

Reinforcement in Columns.

All columns shall have longitudinal steel members so ar-

ranged as to make the columns capable of resisting flexure. These longitudinal members shall be stayed against buckling in the manner specified under heading (a) and (b). In no case shall the combined area of cross section of the longitudinal members be less than one per cent, nor more than four per cent of the area of the concrete used in proportioning the column.

No joints in the longitudinal members shall be allowed except at floor levels, and at such joints the longitudinals of one story shall overlap the longitudinal of the next story by not less than 18 inches.

(a) *Hooped Columns.*

The hooping shall consist of steel rods in the shape of a circular helix of a uniform pitch not exceeding one fourth the coil diameter or four inches nor less than two inches. The volume of hooping metal, per unit length of column, shall not be less than 0.75 per cent of the volume, per unit length of column, of the concrete enclosed by the hooping. Splices which may occur in the hooping shall be made to develop the full strength thereof.

The longitudinal bars shall be not less than 6 in number or less than 0.19 sq. in. in section and shall be symmetrically spaced at distances apart not greater than 8 inches. Each longitudinal bar shall be securely wired to the hooping at not less than every third intersection.

The load on a hooped column shall not exceed that given by the formula:

$$P=750 (C+15 A)$$

wherein P =Safe load in pounds.

C =Sectional area of Concrete within the hooping in sq. in.

A =Aggregate sectional area of longitudinal bars in sq. in.

(b) *Banded Columns.*

In columns where horizontal bands or ties are used in place of steel hooping, these bands shall have a minimum cross-section of 0.05 square inches and shall be spaced not further apart than twelve times the diameter or least side of the longitudinal rods, and in no case more than 12 inches. Each band

shall be securely wired, to the longitudinal bars at not less than every fourth intersection. All splices shall be made so that the full strength of each band is developed.

The load on a banded column shall not exceed that given by the formula:

$$P=500 (C+15 A)$$

wherein P =Safe load in Pounds.

C =Sectional area of concrete not counting the outside one inch.

A =Aggregate sectional area of longitudinal bars in sq. in.

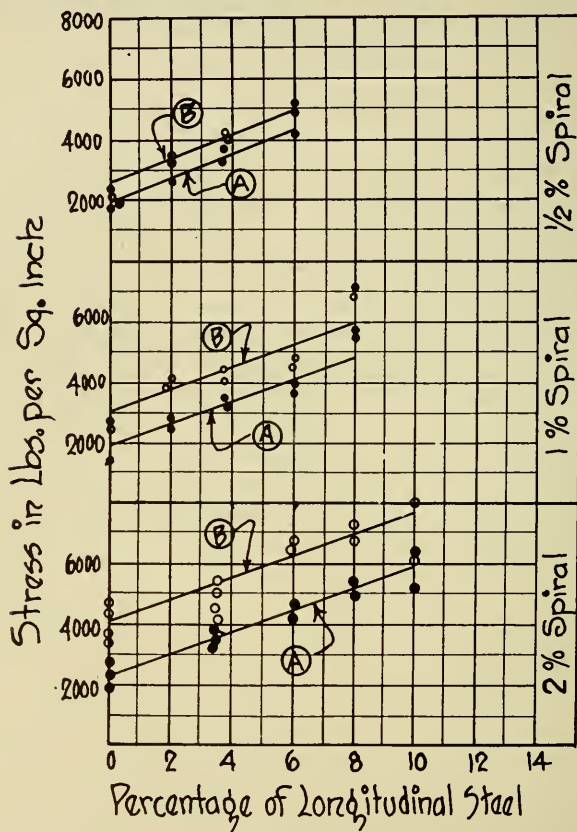
To illustrate the safe loads on hooped columns for different percentages of reinforcement under the rule proposed by your committee in comparison with the safe loads adopted in the present Building Code of St. Louis, the proposed New York Building Code, the Chicago and Detroit codes and the specifications of the joint committee, American Society Civil Engineers, the second appended diagram has been prepared. This diagram also indicates the yield point and ultimate strength of hooped columns as per results of tests by Whitney and Talbot.

(Signed)

CARL GAYLER,
HANS TOENSFELDT,
CHARLES W. MARTIN.

Effects of Reinforcement On Strength of Columns

70 Bulletin Univ. Wisconsin No 466 --- Series of 1910



(A) denotes "Yield Point"

(B) " " "Ultimate"

RECEIPTS AND EXPENDITURES FOR 1914

Receipts.

Cash received from ex-Secretary Fred Brooks.....	\$1,809.65
Engineers' Club of St. Louis.....	913.75
Civil Engineers' Society of St. Paul.....	162.46
Montana Society of Engineers.....	298.12
Technical Society of the Pacific Coast.....	225.46
Detroit Engineering Society	180.83
Louisiana Engineering Society.....	431.96
Utah Society of Engineers.....	348.69
Oregon Society of Engineers.....	274.57
Subscriptions	401.20
Sales of Journal.....	70.44
Advertisements	134.46
Sales of reprints	69.50
Interest on deposits	17.85
Sales of exchanges, etc.	47.08
	<hr/>
	\$5,386.04

Expenditures.

Journal (January to November, 1914, inclusive).....	\$1,966.53
Reprints	19.50
Addressograph	52.96
Addressograph supplies	69.35
Salary to Fred. Brooks for 1913.....	900.00
Salary to Joseph W. Peters, Dec., 1913, to Nov., 1914, inclusive	900.00
Postage	230.68
Stationery	64.38
Collection charges (Bank exchange)	6.20
Typewriter	83.25
Shelves for back numbers of Journal.....	48.00
Freight and transfer charges.....	50.06
Sundries	44.39
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	\$4,435.30
Cash on hand, December 31, 1914.....	950.74
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	\$5,386.04

Statement of Assets and Liabilities will be published in the March, 1915, issue.

JOSEPH W. PETERS, *Secretary.*

Editors reprinting articles from this JOURNAL are requested to credit the author, the JOURNAL OF THE ASSOCIATION, and the Society before which such articles were read.

ASSOCIATION OF ENGINEERING SOCIETIES

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MARCH, 1915.

No 3

This Association is not responsible for the subject-matter contributed by any Society or for the statements or opinions of members of the Societies.

PRODUCTION AND APPLICATION OF ULTRA-VIOLET RAYS, PARTICULARLY FOR WATER PURIFICATION.

BY MAX VON RECHLINGHAUSEN,* PH. D.

[Read before The Engineers' Club of St. Louis, February 24, 1915.]

Vibrations in the ether become manifest in different ways according to their varying wave lengths. Ultra-violet rays, the only one of interest to us in this discussion, have a wave length varying between 0.4μ and 0.1μ .

The minimum wave length of the rays sent to us by the sun is 0.3μ . We obtain the richest supply of ultra-violet rays from electric discharges or arcs between metal points. Among these the most typical, and in fact the only one applied industrially is the mercury arc. Spark discharges between solid metals like aluminum or cadmium are also powerful sources of ultra-violet rays, but the complicated electrical accessories necessary make them inconvenient as industrial sources for these wave lengths. Let us therefore consider only the mercury arcs.

The prototype, namely the Cooper-Hewitt lamp, does not show any ultra-violet rays because its envelope is made of glass which does not transmit ultra-violet rays. Quartz was chosen therefore as an envelope, because it transmits practically all of the ultra-violet rays produced by the mercury arc.

*Formerly associated with Walter Nernst and Victor Meyer at Heidelberg, and Doctors Henri and Helbrommer at the Sorbonne, on light investigations; later research engineer for the Westinghouse Elect. Co. and Cooper-Hewitt Elect. Co.; now Consulting Engineer for several ultra-violet ray companies.

If we expose water germs for a fraction (1-20) of a second to such a mercury arc they will be annihilated. We find that the time required to kill, varies somewhat for the different types of germs. However, these variations are not nearly so great as the variations in restivity of the same type of germs to a chemical disinfectant. The sensitivity of the germs is quite constant enough to allow us to calculate the size of sterilizing apparatus and determine the speed of flow beforehand.

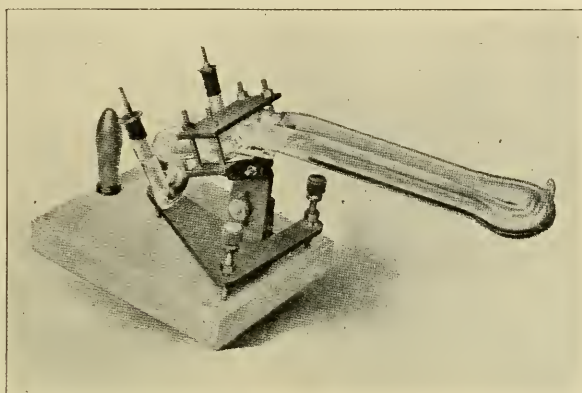
One of the fundamental factors to be considered in this method of water sterilization is the ultra-violet power of the lamps. We have found that this varies directly with the temperature of the lamp. We have found, also, that the lamps may be run, without deterioration, when the walls are nearly at red-heat, so this was adopted as the normal running temperature. It is necessary that there be no contact between the luminous portion of the lamp and the running water, for such contact would naturally reduce the lamp temperature, and therefore seriously impair its efficiency. The maintenance of a high lamp temperature is the first desideratum to be considered in ultra-violet ray sterilization.

Ultra-violet rays are absorbed by glass and by nearly any substance which is opaque to ordinary light. As a matter of fact, clear quartz is practically the only solid which allows the rays to pass through. Water is practically the only liquid known to be transparent to ultra-violet rays. A second principle is therefore established: only clear transparent water should be delivered to the apparatus for purification. Hence filtration is necessary in most cases before sterilization.

As even the clearest waters contain some microscopic suspensions, it is found necessary to agitate the water while it is being illuminated. This causes all sides of the suspensions to be subjected to the light. The proper agitation of the water undergoing treatment constitutes another principle embodied in the process of ultra-violet ray sterilization. The apparatus for this sterilization consists merely of a tank through which the water passes, coming, as it does so, into strongly illuminated zones several times.

In the smaller apparatus where economy of operation is not the main problem, the lamps are placed above the water. They throw their light downward into the liquid which is being properly agitated by a system of baffle plates. For the larger ap-

paratus the question of economical operation is of decided importance, and here a special type of construction is used. For this purpose the so-called pistol lamp, which is the most efficient



Pistol Lamp.

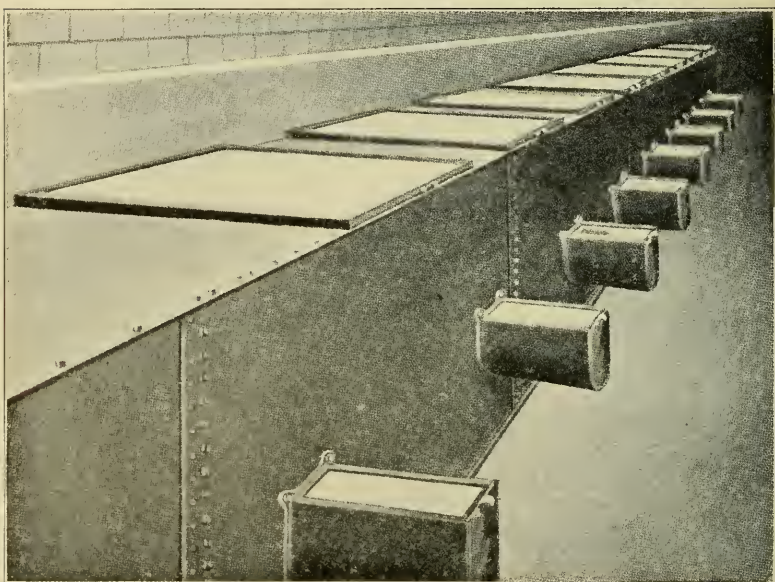
producer of ultra-violet rays, was developed. One or several of these lamps are placed in the sterilizing tanks, which are designed so that the required stirring occurs during the illumination. Very large installations, embodying as many as ten pistol lamps in a single unit, have been built for municipal water supplies. The pistol lamp allows the construction of a type of apparatus which can be used on pressure or suction lines.

Filtration, which is the commonest system for water purification, produces, if the plant is properly built and operated, a physically good water; that is, water free from suspended matter and dissolved color. From a bacteriological point of view, however, filtration alone is not satisfactory, especially when working with polluted raw waters. Satisfactory results are not obtained during the period of starting or at a time when a quick change in the rate of flow occurs. This is particularly true of slow sand filters. It is evident that in some cases a physically good effluent must be considered hygienically unsafe. It may contain residues of human or animal infection which are carriers of typhoid, dysentery, cholera, etc. The typhoid rate has been cut down 75 per cent by filtration in general. The remaining cases, however, were so many that often it became necessary to supplement the filtration process by some other process to reduce

the bacterial contents. Hypochlorite of lime, liquid chlorine, and ozone are used for this purpose.

Satisfactory bacteriological results may be obtained in many cases by using these chemicals, but there are serious objections to their constant use. Improper mixing is the cause of irregular results at times. The spores are not eliminated by this treatment, and they may be disease carriers, while in some cases a revival of the germs has been noticed after apparent extermination.

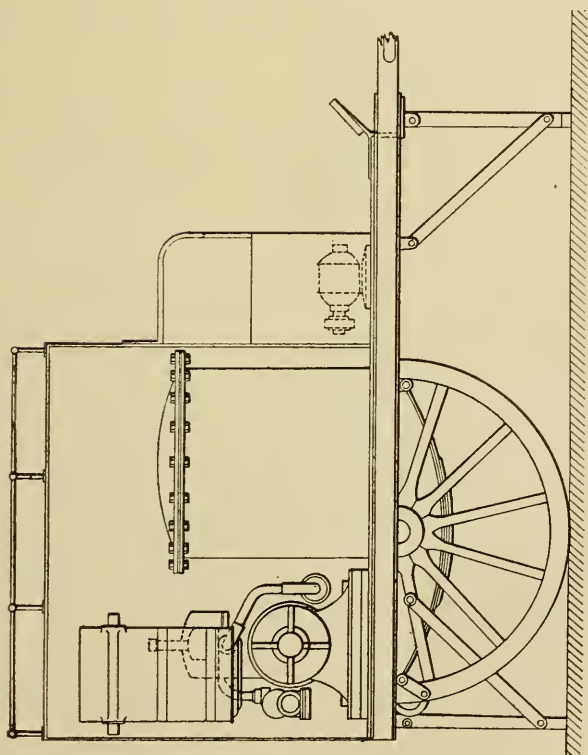
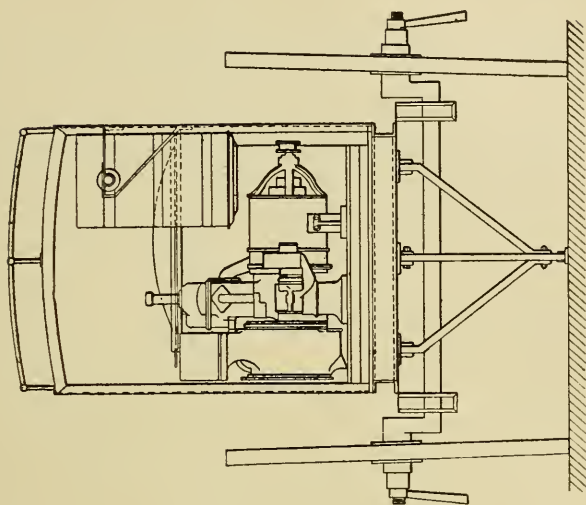
The production of a taste and odor in the water by the addition of chemicals is a great inconvenience because it does not



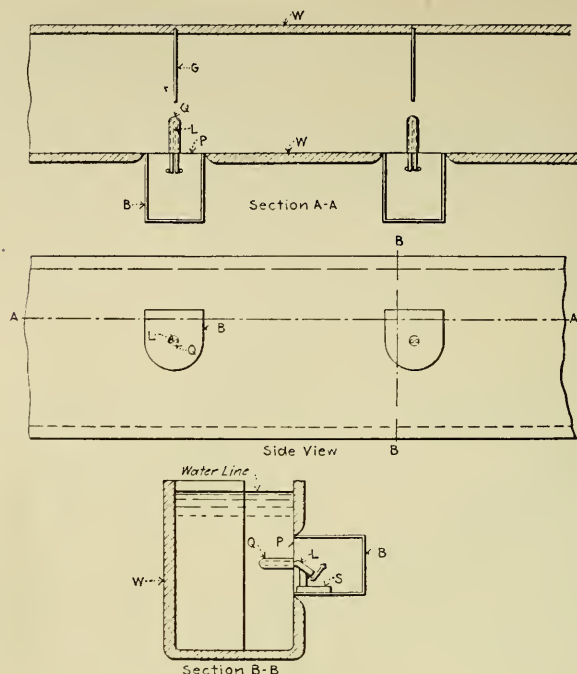
Sterilizing Canal with 10 Lamps, City Waterworks, Luneville, France.

allow a sufficiently large dose to be applied to make the water absolutely safe. This peculiar and very disagreeable odor and taste often render the water unfit for consumption. A trained chemist should always be in charge of the treatment so that the amount added will not be too small for public safety, nor too large for public convenience. Chemical treatment of water has been objected to in many cases and is generally declining in favor. The very low factor of safety allowable is a constant source of uneasiness to the responsible hygienist.

If we now consider treatment with ultra-violet rays, rather



Austrian Army Type.



Canal Type.

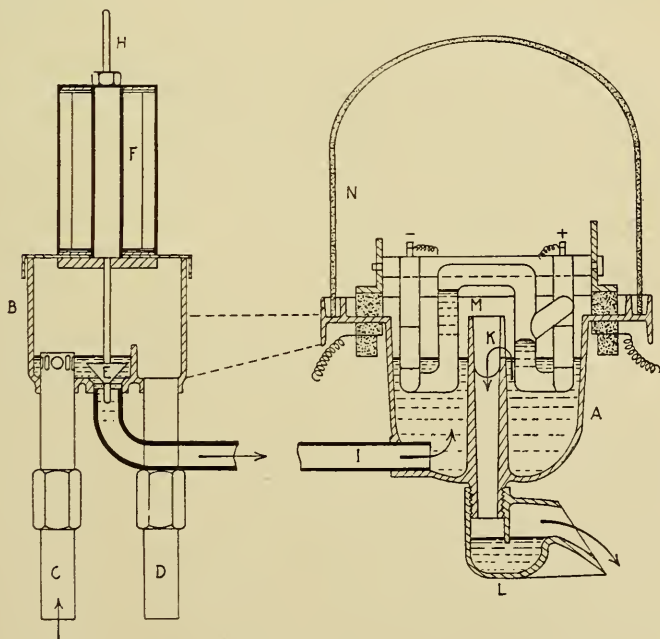
- W-W Outer Walls of Canal.
 B-B Lamp Boxes.
 Q-Q Quartz Globes.
 G-G Baffle Plates.

than chemicals, we find that none of the inconveniences noted above are experienced. The water may be over-dosed to any desired degree without creating a nuisance. This permits the use of an infinitely greater safety factor than is allowable when using chemical disinfectants, which combined with the fact that the spores are killed by ultra-violet ray sterilization, is most desirable from a hygienic point of view.

As stated before, filtration is necessary in most cases before sterilization, just as it is necessary before disinfection. The difference lies in the fact that where a sterilization system is to be used, so much attention need not be given to the clarifying and bacteria removing powers of the filter, although it is better for economic reasons to deliver an absolutely clear water to the sterilizing apparatus. Waters can, nevertheless, be treated which are either naturally, or because of insufficient filtration, turbid and colored. If the turbidity ranges from 0 to 5, a 99 per cent re-

removal is obtainable; 97 per cent removal is obtained with a turbidity above 25, and 95 per cent with turbidity around 50. These facts are the results of a series of experiments made by the Canadian health authorities. Color interferes but little with the economy of the system, provided it is not too high. Water is being treated successfully in large municipal plants where the color runs up to 40 U. S. Ordinarily, the filters can be speeded up considerably, thereby reducing the cost of operation of the plant.

A mercury lamp will go out frequently as it nears the end of its life, so the operator is warned in ample time to provide for renewal. This insures continuity of service. Aside from making occasional renewals, the operator's duties consist merely of properly regulating the lamps when they are put in service. If the water varies in physical quality the number of lamps required for satisfactory sterilization varies. With a little practice the operator, by a simple checking of the color of the water, can determine the number of lamps needed in service. It is therefore clear that labor in connection with this sterilizing system is negligible.



A. Small Unit for Household Use.

It is obvious that the operating cost of a system of sterilization depends on the type and size of the apparatus used, and on the price paid for electricity. The small apparatus, which is least economical, requires approximately $\frac{1}{2}$ to 2 kw.-hrs. to sterilize 400 gallons of water. The apparatus using the pistol lamp is most economical, because, as stated, the lamp is the most economical producer of ultra-violet rays and because its location in the sterilizer allows the use of all of the light. On a physically good water, such as a mechanical filter plant usually delivers, approximately 50 kw.-hrs. per million gallons of water are required. This includes a specially large safety factor, which no chemical sterilization system ever has. It also allows for a falling off in candle-power and other contingencies. In some cases, 30 kw.-hrs. per million gallons may be ample. Based on a cost of \$.001 per kw.-hr., the charge for electricity is \$.03 per million gallons. To this must be added a light charge for lamp renewals, to obtain the cost of operation.

The ultra-violet ray sterilization system has been used for five years in several European plants. The bacteriological and hygienic results have been most satisfactory. Practically all water-born disease have been eliminated in these communities.

This system is being used for the treatment of water for swimming pools, which is exposed to continuous reinfection by the bathers. Such water when untreated often shows a count of thousands of germs per cubic centimeter, and the presence of *B. Coli* in great numbers. In pools where the sterilizer has been placed in the circulation system, the water has proved by tests, to be better than ordinary drinking water.

The long list of possible uses for this type of apparatus cannot be enumerated, but it is especially applicable for use in stores, hotels, institutions of various kinds and manufacturing plants, or where sterile water is desired either for the consumption of the employes or in the process of manufacture, etc. Many steamers on the Great Lakes have installed ultra-violet ray sterilizers to treat lake water before serving it to the passengers.

Nature's method of purifying water is to clarify by sedimentation, and then purify by the action of the sun rays. There is a striking resemblance between this method and the ultra-violet ray method which will take a clear water and sterilize by using the same rays that are effective in the sunlight.

The simplicity of the ultra-violet ray process of sterilization and the thorough elimination of all disease-bearing germs and spores without a resulting nuisance, recommends it as one of the most valuable water purifying processes known to-day.

[NOTE—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

THE CREOSOTING OF CROSS TIES AS PRACTICED BY AMERICAN RAILROADS.

By A. C. STEINMAYER,*

MEMBER OF THE ENGINEERS' SOCIETY OF SPRINGFIELD, MISSOURI.

[Read before the Engineers' Club of St. Louis, March 3, 1915.]

Before going into the matter of the creosoting of ties as practiced by American railroads to-day, it will be well to briefly describe some of the conditions which have brought about the demand for treated ties.

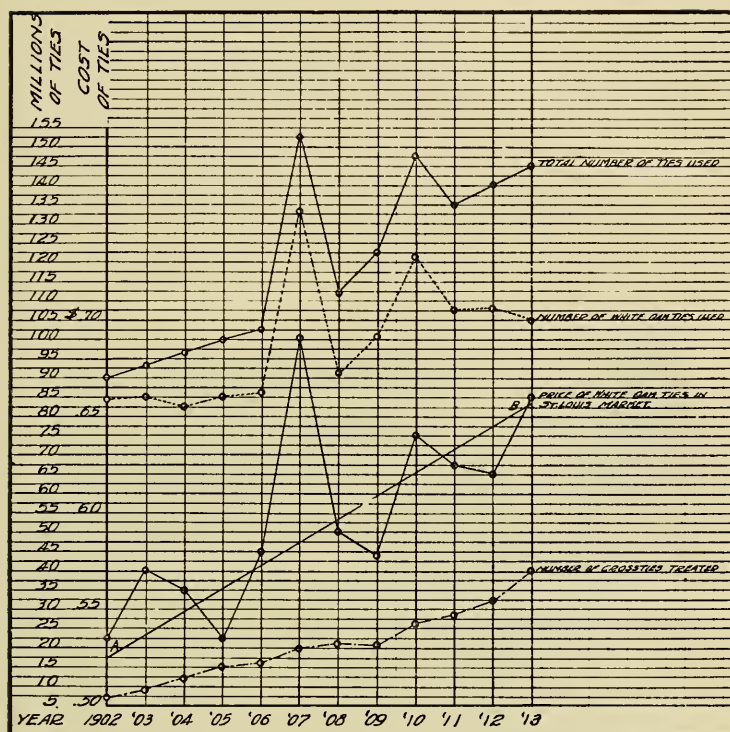
The supply of ties for the railroads of the United States is becoming a more serious problem every year. The annual requirements to-day is estimated at 150,000,000 ties. Their average cost to the railroad companies is possibly sixty-five cents per tie, thus making an annual expenditure of approximately \$100,000,000 for this item alone. With the rapid consumption of timber and the greater demands of an ever increasing population, the price of ties will become higher and higher in the future. From 1902 to 1907, the average price of white oak ties in the St. Louis market increased from fifty-three to sixty-nine cents, or over thirty per cent.

In the accompanying chart, I have shown, graphically, the annual tie requirements of the railroads and electric lines from 1902 to 1913, the number of white oak and treated ties used during this period and the corresponding average price of white oak ties in the St. Louis market. The range of prices of ties, it will be noted, closely follows the variation in the total number purchased. The rapid increase in the number of treated ties has had, thus far, little effect on the increasing price of white oak ties. This indicates that even with the additional timber made available by the treatment of ties, the scarcity of white oak timber for tie purposes was such that during the period covered there was a tendency for the price of white oak ties to increase at the average rate of one cent per year, as is shown by the straight line "AB". No doubt if there was not this competition between the white oak and treated ties this increase would have been much more abrupt.

Treated ties have influenced the cost of the white oak ties in two different ways:

First—The treating of ties has made it possible to use inferior timbers having no rot-resisting properties, which are very abun

*General Treating Inspector, St. Louis & San Francisco Railroad.



Annual tie requirements of the railroads and electric lines from 1902 to 1913, showing the number of white oak and treated ties used during this period and the corresponding average price of white oak ties in the St. Louis market.

dant and for which there was practically no market previously.

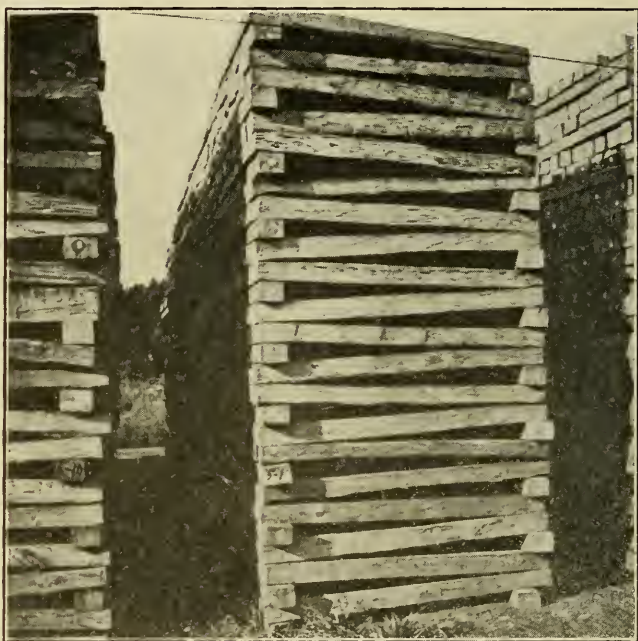
Second—The increase in the average life of the ties, due to the use of treated ties, is causing a decreasing average tie renewal requirement per mile of road operated.

White oak ties make up the largest percentage of ties used in the past. The number of years' service obtained of them varies considerably at various points in this country, depending upon the climatic conditions, the grade of timber and the protection given them from mechanical wear. On an average they last about eight years. With the increased scarcity of white oak timber and the increased consumption for purposes other than ties, the grade which will be available for ties will become more inferior every year, so that a decreased average life will result.

The principal cause of the failure of such ties is decay. Investigations made by the American Railway Engineering Associa-

tion have resulted in attributing the failure of 87 per cent of our first-class tie timber is this factor. Confronted with these conditions, it will be seen that a steady, rapidly increasing expense in maintaining our railroads was inevitable unless a substitute for white oak ties was found.

The preservation of ties with chemicals was begun in this country on a considerable scale, about 1885, when about 120,000 ties were treated. Since that time this industry has grown by leaps and bounds. In 1913, 40,000,000 ties, or nearly 30 per cent of the



Careful manner in which red oak ties are stacked to reduce loss through excessive checking during seasoning.

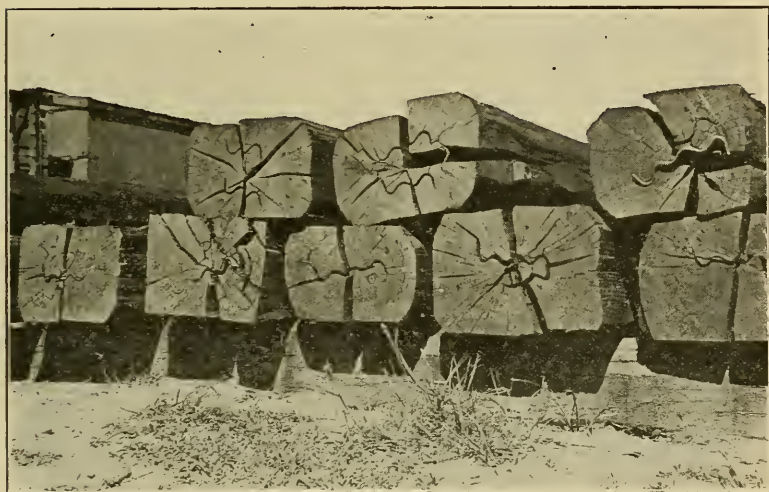
total ties used that year, were treated by the wood preserving plants.

The extensive creosoting of ties was not begun until about 1905, when only ten per cent of the total number of ties treated during that year were impregnated with creosote oil. In 1913, over 60 per cent of the total ties treated were impregnated with creosote oil. A discussion of the relative merits of zinc chloride, creosote oil and other preservatives which are used at the present time, will not be entered into. Suffice it to say that the rapid growth of the

use of creosote as a preservative must appeal to everyone as indicative of great faith in its properties to keep wood from decay.

Whether or not this rapid growth will be similarly maintained in the future is dependent, in a great measure, upon increasing the production of creosote oil.

Creosote oil is a by-product obtained by the distillation of tar which in itself is a by-product of gas works and by-product of coke ovens. Coal tar is mainly distilled for benzol, crude carbo-lic acid, anthracene, hard and soft pitch and such products. The creosote oil is only a small percentage of the distillate, comprising in the main that fraction coming off between 240 and 270



Result of improper care being taken of some red oak ties while seasoning.

degrees centigrade, and usually such other distillates as cannot be used for any other purposes. As the tar cannot profitably be distilled for the production of creosote alone, its supply is determined, fundamentally, by the commercial and technical conditions governing the production of material, in which the wood preserver is not directly interested. At the present time only 40 per cent of the creosote oil used in this country is manufactured here, the balance being imported mainly from England, some from Germany and a small amount from Belgium. The rapid installation of by-product coke ovens and a more extensive market for pitch, will, no doubt, have a tendency to increase the output of creosote oil in this country in the near future.

While in general the railroads have adopted as a standard the specifications for creosote oil for tie treatment as approved by the American Railway Engineering Association—in view of the above, it will be seen that the nature of the tar distiller's products is very indefinite and that unless considerable variation is allowed from the specifications, a very limited supply of high-priced creosote oil would result.

This specification follows:

"The oil shall be the best obtainable grade of coal-tar creosote; that is it shall be a pure product obtained from coal gas tar or coke oven tar, and shall be free from any tar, oil or residue obtained from petroleum or any other source, including coal gas tar or coke oven tar; it shall be completely liquid at thirty-eight (38) degrees centigrade and shall be free from suspended matter; the specific gravity of the oil at thirty-eight, (38) degrees centigrade shall be at least 1.03. When distilled by the common method—that is, using an eight (8) ounce retort, asbestos covered, with standard thermometer, bulb one-half ($\frac{1}{2}$) inch above the surface of the oil—the creosote, calculated on the basis of the dry oil, shall give no distillate below two hundred (200) degrees centigrade, not more than (5) per cent, below two hundred and ten (210) degrees centigrade, not more than twenty-five (25) per cent below two hundred and thirty-five (235) degrees centigrade, and the residue above three hundred and fifty-five (355) degrees centigrade, if it exceeds five (5) per cent in quantity, shall be soft. The oil shall not contain more than three (3) per cent water."

The process of creosoting ties may be divided into two operations:

First—The preliminary seasoning.

Second—The injection of the creosote oil.

Seasoning of ties.

Timber in seasoning undergoes other changes besides the evaporation of water, which make the wood permeable to liquids and gases. Just what these changes are does not seem to be definitely known at this time. In treating plant practice seasoning is brought about in three different ways:

(1) By steaming.

- (2) By boiling oil.
- (3) By air-seasoning.

At the beginning of the treating industry in this country, seasoning was mainly conducted by steaming. The material after being placed in the cylinder and doors closed, was subjected to a bath of saturated steam under varying degrees of pressure and time depending upon the size, grades and condition of the timber. After the completion of the steaming process, a vacuum was applied from one to two hours. Because of the weakening of the material, especially when subjected at too high a temperature, also



Electric locomotive used in hauling the trams about in the tie yard and for charging and emptying the treating cylinders.

for economic reasons, steam-seasoning has been pretty generally superseded by air seasoning.

Seasoning by boiling in oil, has been carried on only to a very limited extent, mainly on the Pacific Coast. Wood is submerged in creosote oil and its temperature raised from 215 to 225 degrees Fahrenheit. This boiling is continued from twelve to twenty-four hours, depending upon the character of the timber and its condition.

Air seasoning has been adopted by most treating plants to-day as the best manner for putting ties in a proper condition for treat-

ment. For the purpose of air-seasoning, extensive yards are built, usually in conjunction with the treating plant, to which the ties are shipped as soon after cutting as practicable, and there stacked in a manner most suitable for the timber in question, so as to minimize the checking and loss through decay during the seasoning period.

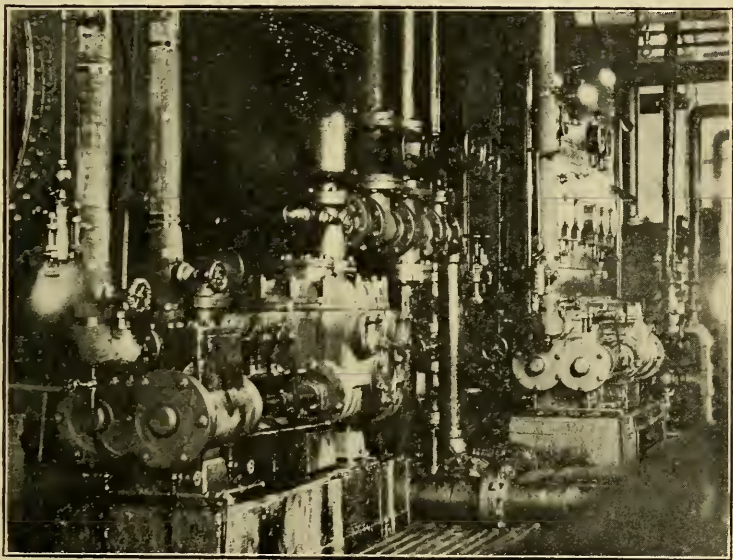
When timber is exposed to the sun and wind, the water will evaporate more rapidly from the outer than from the inner parts of the ties and more rapidly from the ends than from the sides. As the water evaporates, the wood shrinks, and when the shrinkage is not fairly uniform, the wood cracks. A form of stacking is therefore adopted which reduces the area of the ties exposed to the elements to a minimum and which creates conditions within the pile that will make the evaporation of moisture as uniform as possible throughout the tie, without endangering them to early decay. A rigid culling of defective timber at this time and keeping the yard clean of decaying timber and vegetation, reduces the danger of the ties becoming infected with decay during this seasoning period.

The grouping of the ties to secure uniform treatment is most effective if carried on while the ties are being stacked for seasoning. The resistance offered by the timber to the entrance of the creosote oil, varies with the species of wood, the per cent of sap, and heart wood and the moisture content. The average cylinder charge at a treating plant consists of 600 to 1,000 ties, and unless these are of the same permeability, a large variation will occur in the amount of oil left in the individual ties of the charge. Some of the ties, easily impregnated, will receive an amount greater than the mechanical life of such ties would warrant. Consequently, much of the oil will be wasted, whereas, others will not receive a sufficient amount of oil to properly preserve the wood from decay. The success of the treatment of ties depends probably more upon their proper segregation and seasoning and subsequent selection in making up the individual charges before being placed in the treating cylinder than any other factor.

When partially seasoned in the woods, on the right of way or on the banks of a river, the discoloration of the ties from winds and rain, and their general resulting condition make it practically an impossibility to segregate them as to age; the species and percentage of heart and sap wood are less easily distinguishable; the

ties are usually checked badly and there is danger of their having been slightly infected with decay, which, although not evident at the time of stacking the ties in the seasoning yard, will develop later on, when they must be removed at considerable cost, to avoid infection of the remaining ties in the pile. The importance then of shipping the ties to the seasoning yard as soon after cutting as practicable is evident.

The general practice among the different plants to-day is to season their timber a sufficiently long period to make the weight per cubic foot of timber fairly constant, or to reduce the moisture content to about twenty per cent. In red or black oak ties, usually a year is required to bring about this condition; beech and hard



General service and pressure pumps for forcing the creosote oil into the ties. At the right is the gauge board with recording gauges to record the pressure, vacuum, and temperatures used during the treating operations.

maple ties, eight months; gum, six months, and pine, three to four months. However the nature of the timber, the climatic conditions in the seasoning yard and the time of the year, so greatly affect the seasoning that no set rules in regard to the length of time required for seasoning can be laid down.

In grouping the ties on basis of species, treatment ties of the red oak family including red oak, pin oak, black oak, water oak,

willow oak and turkey oak are grouped together to advantage or beach and hard maple, and certain other combinations, depending on the locality. Beech, elm, gum, and fir are treated separately. A division of the pines is usually made according to the per cent of heart and sap wood.

Treatment of ties.

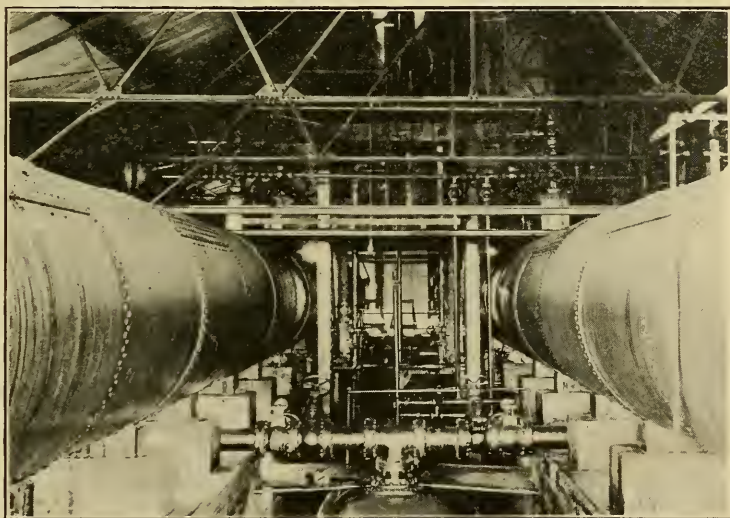
The cost of creosoting a tie, exclusive of the preservative, is from eight to twelve cents. The cost of creosote oil is from six to eight cents per gallon and constitutes the most expensive item. The cost of the creosoted tie therefore varies usually in a ratio with the amount of oil injected. The practice among the American railroads in the past has not been conducive to a long mechanical life of the ties. A sufficient amount of the preservative, then which would probably prevent decay of the wood during the mechanical life of the ties, has been their aim in treating plant operations. As conditions change to permit of better rail fastenings, larger plates, etc., no doubt we will see an increased amount of creosote left in the ties so as to give a similar additional protection to the timber from decay.

At the present time on an average probably less than three gallons of creosote oil per tie is being left in them, whereas, an average of four to six or more gallons could be forced into the timber, depending upon the species. As one of the axioms in the preservation of timber is, *get thorough penetration*, and because of the excessive cost of the tie when containing a large amount of sap wood if impregnated with an amount of oil sufficient to fill all of the interstices in the wood, the adoption of several so-called "empty cell" processes has resulted, wherein an attempt is made to get thorough penetration with a small amount of oil. This has made it possible to creosote a tie at a cost of twenty to thirty-five cents, and the results to date indicate that the wood is apparently fully protected from decay for a very considerable period of time, which is probably equal to the mechanical life of the ties according to the best maintenance practices on most roads.

Of the full-cell processes, the Bethel may be taken as representative. When treated by this process, usually all the creosote the timber will hold is forced into the ties. Because of the large quantity necessary to do this when the timber contains a large percentage of sap wood, the cost of the tie so creosoted becomes very excessive, and is seldom warranted. The process is, there-

fore, confined more especially to the treatment of ties of refractory timber, containing small amounts of sap wood. At the present time, possibly less than 15 per cent of all the ties creosoted, receive full cell treatment. The balance, or about 85 per cent are treated by empty-cell processes, of which the Rueping and Lowry processes may be taken as representative.

The theory underlying the Rueping process, in brief, is to make use of the expansion of the air introduced in the cells of the wood to force out a great deal of the surplus oil which has not been actually taken up by the wood itself when the pressure is released and a vacuum created in the retort. Different manipulations of the air pressure, creosote pressure and vacuum, makes it possible to gauge within very wide limits, the average net amount of oil



Interior view of Springfield tie treating plant showing relative positions of charging tanks, treating cylinders and emptying tank.

left in the ties. Some roads to-day are getting a thorough penetration and leaving in the tie an amount of oil equivalent to but five pounds per cubic foot of timber. Treatment by the Lowry process gives similar results by the application of a quick, high, final vacuum without any preliminary air pressure being applied.

In both of these processes a large proportion of the oil originally injected into the timber is recovered the amount depending upon the species and its general condition. The manner of conducting the treatment does not usually seem to interfere with obtaining

a penetration of all the treatable portions of the ties—that is, all of the sap wood and a varying quantity in the heart wood, depending upon the species.

Because of the comparatively recent adoption of creosote oil as a preservative in treating ties on a large scale in this country, and the fact that but very few service records have been carried on a sufficient length of time to obtain data, the success of many American practices to-day is still a matter of opinion. From my personal observations and from reports which have come to me based on the examination of several millions of creosoted ties which have been in use from five to seven years, I feel confident that an average life of at least fifteen years will be obtained of most of them.

In my remarks thus far, I have attempted to cover briefly and in a very general way, some of the conditions which have brought about a demand for treated ties; the rapid growth and magnitude of the treating industry to-day, more especially with reference to the creosoting of ties; the handicap which the limited production of creosote oil may be in maintaining a similar increase in the future; the seasoning of ties, its object and conditions which must be met to reduce the loss from checking and excessive decay to a minimum; the necessity of properly segregating the ties as to dryness and species in making up the cylinder charges in order to get uniform penetration; the theory underlying the different methods in use of impregnating the ties with creosote oil and some of the reasons for the popularity of the empty-cell processes, also the life which may be expected of the creosoted ties.

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

BUILDING LAWS

DISCUSSION BY R. FLEMING.*

[Volume 53, page 237, November, 1914.]

A paper on "Building Laws," by Henri Rusch in the Journal of the Association of Engineering Societies came to my attention last week. I note that you invite further discussion of this paper.

You may or may not be aware of the series of articles by me in the current numbers of the *Engineering News* on the general subject of wind action. The last of the series, which will appear in an early number, is entitled "Wind Bracing Requirements in Municipal Building Codes." The past year or so I have examined the codes of 122 cities with reference to this matter, and I conclude my article with a recommendation that the provisions of the Chicago code be adopted. My reason for doing this is that I think a horizontal wind pressure of 20 lbs. per sq. ft. for every square foot of exposed surface is sufficient, and I also think that for stress produced by wind forces combined with those from live and dead loads the unit stresses may safely be increased 50 per cent over those given for live and dead loads alone.

My criticism of the provision for wind bracing in your proposed St. Louis code is:

1. 30 lbs. is more than is needed.
2. Your sentence, "Where there are buildings immediately adjoining the wall surface covered by such buildings will be considered as not exposed to wind pressure," is objectionable. It is not clear what you intend to consider where a building adjoins a street corner. The adjoining buildings may easily be removed at some future time.
3. It is not clearly stated whether the 20 per cent addition you allow is for wind stresses alone or for wind stresses combined with other stresses. It may be stated that for occasional stresses like those produced by the wind the 20 per cent addition can easily be changed to 50 per cent.

The strength of a building as far as the wind bracing is concerned is measured by the strength of the connections to the columns as well as by the strength of the girder and joist sections. This is apparently forgotten in many designs. I doubt if

*30 Church Street, New York City.

one office building in ten in St. Louis will measure up to the requirements for wind bracing in your present building code in both design and details.

My plea is that rational assumptions should be made and there should be a strict adherence to them throughout.

REPORT OF THE SECRETARY OF THE OREGON SOCIETY OF ENGINEERS FOR THE YEAR 1914

[Read at the Annual Meeting of the Society, February 1, 1915.]

Mr. President and Gentlemen:

The activities of our Society during the past year as seen through the Secretary's spectacles have been as many colored as the spectrum, and as shifting as the scenes of a kaleidoscope. At times the bright, cheerful colors shut out from view all suggestions of trouble, while at other times, the brightness vanished, and nothing was seen but the dark blue of despair.

A year ago the membership was 203 active, 32 junior members, and 3 associates, a total of 238. Seven active, and two junior members who were a year or more in arrears were also carried on the mailing list in the hope that they would fall heir to a million, and pay up. But they didn't.

Five active members were added by election in June, and eight in December; two of the latter being transferred from the grade of junior.

For a multitude of reasons, chief among which is a lack of steady employment, it has been necessary to drop for non-payment of dues, or to accept the resignations of 62 active members and 15 juniors, leaving the present membership of 155 active, 16 junior, and 3 associates; a total of 174 members of all grades.

Considering the state of the market for engineering services in this vicinity, this is not as bad a record as it might have been.

There have been nine regular, and two special meetings of the Society during the year for the discussion of business or technical subjects. The attendance at these meetings varied from 9 to 80, the average being 35.

Eleven luncheons were held at the Benson Hotel, with an average attendance of 43, varying from 75 at the first one, to 19 at the last meeting.

The Program Committee deserves the thanks of the Society for the manner in which the entertainments during the year have been handled, and it is to be regretted that an unnecessary alarm about the cost of announcements brought on an attack of "cold feet" in the Committee, causing the luncheons to be discontinued.

There has been considerable of a demand for these luncheons to be resumed, and the suggestion has been made that if they were

held on Saturdays, a much larger attendance, especially of salaried office men could be secured.

The Journal of the Association of Engineering Societies is sent to each active member whose dues are paid in advance, the only exceptions being those who have paid up in the last two months. If these members desire the numbers of the Journal to which they are entitled, a note to that effect, when paying their dues for 1915 will bring them.

During the past year there have been published in the Journal 52 pages of matter for which our Society is either directly or indirectly responsible. This is divided as follows: 1 full page cut of President Graves, 23 pages of miscellaneous papers, 9 pages of discussion by other societies of papers from our membership, and 19 pages of proceedings, including the reports of the officers for last year.

This is not a record to boast of.

A partial explanation may be found in the fact that many of the speakers were not members of our Society, and they, as well as several members who addressed the meetings, did so without having their remarks in shape for publication.

I would like to suggest that in the future, when a man is asked to speak before the Society, whether he is a member or not, it should be distinctly understood that he is to furnish a copy of his address for publication in the Society's Journal *before* it is given to any other publication. Only in this way can we make our Journal a paper to be sought after and preserved by engineers, and until this is done, we will have fulfilled our mission as a society only in part.

Our records show that less than 20 per cent of our members attend the meetings. Should we not, then, make as strong an effort as possible to get the results of these meetings before those who have not been able to be present at the meetings?

Another suggestion is that we issue a certificate of membership, so that a member may have something besides the Treasurer's receipt to show that he belongs to a real engineering society.

It is true that we now have a badge, adopted officially by the Society, and worn by 16 active and 3 junior members. Before the next annual meeting we should have ten times as many representative engineers tagged with the little blue triangle that stands for rigid honesty, a square deal, and equal consideration for the rights of both contractor and client.

The employment department has not been idle during the past year, though accurate data have not been kept showing its activities. Positions have been mostly of a minor nature, and temporary; but nevertheless they had to be filled, and sad as it may seem, some of our members were glad to fill them, even for short periods.

It is regrettable that the Secretary has not had more time to devote to this work, as well as to his other duties; and that he has not been so situated that his office could have been more freely used as a reading room and a place for the general exchange of ideas among the members.

A movement was started having for its object the securing of a club house; not in any degree elaborate, but a home for the bachelor members, and headquarters for those coming from out of town. A moderate-sized dining room, with facilities for furnishing luncheon to from 20 to 40 men would be desirable in connection. If such a house could be secured within five blocks of the post-office, it might prove a profitable, as well as a pleasant home for the Society.

The Library Committee outlined a beautiful program for helping employes in the shops to get instruction in the technical side of their work. An enthusiastic meeting with representatives from the Library was held, and then, so far as we have been able to learn, this child of a fertile brain, was abandoned at birth, and now wails helplessly for sustenance and care.

It is a worthy cause. It is a work that will not only help young men who are anxious for assistance and will appreciate it, but will be a big boost for the Society, and will strengthen and broaden the men who put in their time upon it.

The Legislative Committee has reached out its tentacles for everything that in any way approached its line of work, and true to the instinct of the octopus, it has, so far as we have heard, either obscured the issues by its murky exudations, or has crushed them to helplessness in its all-too-fond embrace.

Other special committees have, however, accomplished some results in dealing with the various legislative bodies.

The By-laws Committee has drafted several constitutional amendments which are before you for consideration to-night. You can judge, each for himself, whether this work is or is not satisfactory.

All things considered, we have weathered a stormy season in fair condition, and can take up the work of another year strengthened by the buffetings that we have encountered, and broadened by what has been learned in the school of experience.

ORRIN E. STANLEY, *Secretary*.

OBITUARY

AUGUST CHRISTIAN

EX-VICE-PRESIDENT MONTANA SOCIETY OF ENGINEERS.

In the engineering profession August Christian spent an active and exceptionally useful career. But his services of a material sort to mankind in no way reveal the place he held in the hearts of all who knew him. There was a wholesomeness of personality which dominated in all the activities of his life and which won the confidence of all of those associated with him. His unselfish and modest interest in friends combined with a superiority of judgment naturally brought him to positions of leadership, not only in his exacting profession, but in the community in which he lived.

August Christian was born in Germany in 1853, and died in Butte, November 19, 1914. After completing his education in his native country he came to America as a place of greater opportunity for an active career.

At the time the Union Pacific Railway was projecting its lines through the West and Northwest, Mr. Christian was assigned work on these lines. The years 1883 and 1884 were spent in extensive surveys on the Oregon Short Line branches in Idaho and Montana. He then returned to Cincinnati, Ohio, where he was married and worked for the city engineering department until 1887. For the next two years he was recalled to the staff of the Union Pacific Railway, engaged in surveys and construction work in Kansas, Colorado and Indian Territory. In 1889 he entered the employ of the Montana Union Railway Company, building lines from Butte to Garrison and from Stewart to Anaconda. It was at this time that Mr. Christian became acquainted with Marcus Daly, who engaged him to take charge of the engineering work in connection with his mining enterprises in Butte. From this time until his death Mr. Christian remained in the employ of the Anaconda Copper Mining Company in the capacity of Chief Engineer.

During this period the Anaconda Company was involved in extensive operations, where great dependence was placed upon the efficiency as well as the loyalty of the engineering staff. Mr. Christian's ability measured up to the fullest demands placed upon him at this time. His untiring energy and unassuming disposition were recognized by employers as well as friends.

August Christian is survived by a widow, a daughter and two sons. Both of the sons are employed by the Anaconda Copper Mining Company.

JOHN GILLIE, *Chairman*,
GEO. E. MOULTHROP,
THEODORE SIMONS.

EDWARD DANIEL MEIER

HONORARY MEMBER OF THE ENGINEERS' CLUB OF ST. LOUIS.

Edward Daniel Meier, who died in New York City, December 15, 1914, was born in St. Louis, May 30, 1841. He was the son of Adolphus Meier, a native of Germany, who had come to St. Louis some time before 1838, when we find him registered in the City Directory (the first one published) as a hardware merchant.

In 1856, at the age of fifteen years, Edward graduated from the St. Louis Public High School, after which he spent two years at the Washington University. Then for four years (1858-62) he was a student at the Royal Polytechnic Institute of Hanover, Germany.

From July, 1863, until the close of the Civil War in 1865, he was in the United States military service, first as a member of the 32nd Regiment of Pennsylvania Infantry, then (in December, 1863), as a member of Nim's Second Massachusetts Battery. From this he was promoted (in 1864) to the Engineer Corps, then to the position of 2nd Lieutenant in the First Louisiana Cavalry. And in 1865, at the close of the war, we find him as First Lieutenant and aid-de-camp to General J. W. Davidson. His title of Colonel was acquired in the Missouri National Guard, following his service in the railroad riots of 1877.

After the close of the war he was for some time employed as finisher and draftsman in the Rogers Locomotive Works at Paterson, New Jersey, and following this was appointed Superintendent of Machinery of the Kansas-Pacific Railroad (which later became the Kansas division of the Union Pacific Railroad) with his headquarters at Wyandotte, Kansas. After his resignation from this position, he became interested in various industrial enterprises. Among these were the Illinois Patent Coke Company, the Meier Iron Company,—with a blast furnace at East Carondelet—

and the Peper Cotton Press Company of St. Louis. He also, in 1878, became a member of the firm of Adolphus Meier & Co.

In 1884, Col. Meier organized the Heine Safety Boiler Company for the development in America of the water-tube boiler of that name and was president and chief engineer of the company until his death. He was also largely responsible for the introduction into the United States of the Diesel Engine, after a trip to Germany in 1897 to investigate its merits. And from 1901 till 1908 was the chief engineer and secretary-treasurer of the Diesel Engine Co. of New York.

Col. Meier was an active members of numerous professional and other organizations. Of these, the first was the Engineers' Club of St. Louis, of which he became a member in January, 1873, four years after its organization. From 1881 to 1884, he was treasurer of the Club, and in 1889-90, was the president of the Club. In December, 1910, he was elected an honorary member. He was also a member, vice-president and president of the American Society of Mechanical Engineers; member, secretary and president of the American Boiler Manufacturers' Association and member of the American Society for Testing Materials. He was also a member of the Loyal Legion and other military societies, and of numerous clubs.

Col. Meier was twice married, first in October, 1868, to Clara Giesecke, by whom he had one son, Edward Clarence, and second in June, 1875, to Nancy A. Runyan, by whom he had two sons—Theodore and Clement, and two daughters, Mary and Alice.

As a man, he was frank and hopeful, a cheery companion and a loyal friend, whose memory will long be cherished by all who had the good fortune to know him.

ROBERT MOORE.

JOSEPH F. WANGLER

MEMBER OF THE ENGINEERS' CLUB OF ST. LOUIS.

Joseph F. Wangler was born in Pittsburg, Pa., March 4, 1837, the day on which Martin Van Buren was inaugurated President of the United States. He received his early education in Pitts-boat *Isaac Newton*. Here he worked as an apprentice at the boiler making trade under his father at the old Broadway Foundry and burg, coming with his parents to St. Louis in 1851, on the steam-Machine Works.

He continued at his trade until the outbreak of the Civil War, during several years of which he was employed by the U. S. Navy Department in the construction of river gunboats, at which work he achieved an enviable reputation.

In 1864 he embarked in business for himself, opening a boiler shop and making a specialty of river steamboat work. With the decadence of the river traffic he did a general business in sheet metal manufacturing of the heavier kind, among which may be mentioned work in his line on the Eads Bridge and the Old Water Tower in North St. Louis.

The business was incorporated in 1891 under the name of the Jos. F. Wangler Boiler & Sheet Iron Works Company. He had a high ideal and his shop had the reputation of doing excellent work. He builded the best he knew and wanted nothing else to leave his hands. As a member of the American Boiler Manufacturers' Association, he was active in the movement to raise the standard of boiler material and workmanship.

He belonged to a number of local organizations and took an active though unostentatious part in the business and philanthropic activities of the community. He was one of those to whom in some measure may be attributed the substantial upbuilding of the city.

His taking-away was as peaceful as it was sudden. He had been attending business up to the day of his death, which occurred 9:00 p. m., Saturday, January 9, 1915, while quietly reading at home.

He is survived by his widow, four daughters and two sons, one of whom succeeds him in the active management of the business.

E. R. FISH.

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THE MANUFACTURE AND USE OF PURE IRON

By HOWARD SEE.

[Read before the Oregon Society of Engineers, March 11, 1915.]

During the past ten years there has been a decided step taken in the production of material of greater lasting qualities than those possessed by steel.

Looking back into history for a minute, our attention is called to the fact that before the advent of the Bessemer Steel Process, iron had been manufactured in the puddling furnace. We have to-day many samples of material made by this process, of which definite records are known and which have had remarkable lasting qualities. One of the best known cases is that of the suspension bridge erected at Newburyport, Massachusetts. This bridge was supported by links made of puddled iron. This bridge was built during the latter part of the seventeenth century. It was torn down a few years ago, having been in service for over one hundred years. At the time that it was torn down, the links of the suspending chain were in practically perfect condition.

It happened a few years ago that the attention of the Department of Agriculture of the United States Government was called to the fact that modern steel wire did not have the lasting qualities possessed by the old-fashioned iron wire,

and that department began an investigation and ascertained that these old samples of iron which were known to have great durability were of very high purity, while the steel, which had come into disrepute because of its rapid corrosion, contained relatively large amounts of impurities. That department, after thorough investigation along these lines, determined that this old-fashioned iron was more resisting to corrosion because it was slowly and carefully manufactured and because it had the highest purity.

The modern steel rusted much faster than this old iron, first, because it contained relatively large amounts of impurities, and secondly, because of the strong demand, steel was made rapidly and manufacturers were continually driving for maximum output and for lower costs of manufacture.

The analysis of these old links from the Newburyport bridge, which had lasted for over one hundred years, was as follows:

Sulphur .....	.007
Phosphorus .....	.032
Manganese .....	.010
Carbon .....	.050
Silicon .....	.030
Copper .....	.030
Oxygen .....	.030
Hydrogen .....	.001
Nitrogen .....	.003

Now let us consider for a moment the causes of corrosion for primarily that is what we are interested in and it was to meet the demand for a rust resisting material that pure iron on a commercial basis to-day was developed. Some metallurgists set forth in theory a few years ago that the cause of rust and corrosion was an electrolytic action set up on the surface of the the metal. This is no longer theory, but has been borne out by extensive experimental work.

Steel is iron containing appreciable amounts of impurities. These impurities are not uniformly distributed throughout the mass, but they are segregated or separated out and can be so ascertained under the microscope; that is, there will be spots high in carbon, other spots high in manganese, etc., but manganese is the element with the strongest tendency toward segregation.

An electric battery consists primarily of two elements of different electric potential, these being known as electrodes and they are immersed in a solution known as the electrolyte. The most common form of battery is that in which one electrode is carbon and the other zinc, these being immersed in an electrolyte of dilute acid. In this case the zinc is the positive electrode and the carbon is the negative. If these electrodes are connected by a wire on the exterior a current flows between them and through the electrolyte with the result that the positive zinc is destroyed.

If we take the same electrodes and place them in a very much weaker acid, or even in water, this action still goes on and a current still flows between them. This is distinctly shown by the use of the millivolt meter. These currents are, of course, extremely small, but nevertheless they do exist and the zinc is destroyed just as distinctly as when the electrolyte consisted of an acid. If we take any unlike substances, as for instance iron and copper or carbon and tin and immerse them in water, connecting the outer extremities through a millivolt meter, we will see that a minute current is flowing.

Now let us return to the piece of steel which we were considering. I have just stated that steel is iron containing impurities, chief of which are carbon, manganese, copper, sulphur, phosphorus, and silicon. When that surface becomes moist, we have all the necessary elements for an electric battery; that is, minute spots high in sulphur or manganese or copper, and these of a different potential than the surrounding material. When the surface becomes covered with water or other liquid we have an electrolyte, and an electric current flows from the spot of high potential to the spot of low potential with the result that the more positive points are rusted away, this giving what is commonly known as pitting or tubercular corrosion. The natural way to reduce this corrosion or electrolytic action would be to have the steel absolutely uniform in chemical composition and physical structure. This is not altogether possible. Obviously the most effective way that this can be obtained is to eliminate all of these impurities as far as possible, for by so doing we leave no impurities in the metal to segregate or to form points of higher or lower potential.

The next step after eliminating the impurities would be to

make the material as homogeneous and as uniform in structural form as possible, for a material under strain even though the material is of high purity has different potential from that part which is not under strain, and hence an electrolytic action would be set up and corrosion would result. Copper is extremely negative to iron and hence it is one impurity which especially should be eliminated. The potential difference between it and iron is greater than any of the other common impurities and hence it will cause corrosion when segregated more than any of the other elements.

I now want to show you by means of illustrations the difference in the manufacture of iron and steel. In both the open hearth furnace is used; in both the raw material consists of pig iron and scrap and limestone. But in making rust resisting iron, it is essential to use carefully selected scrap and it is necessary to charge a greater amount of limestone. The open hearth furnace consists primarily of a working chamber approximately 35 ft. long and 15 ft. wide. The metal which is charged lies in the bottom of this chamber and when melted makes a bath about 2 ft deep. Either producer gas, natural gas or oil may be used as a fuel.

Our practice is to charge from 15,000 to 18,000 pounds of limestone and on top of this a mixture of 150,000 pounds of pig iron and scrap. The heat of the furnace brings this to a melting point in from seven to eight hours, and the limestone which had originally been on the bottom becomes fluid and floats to the surface, carrying with it practically all of the phosphorus and some of the sulphur. The thoroughness with which these two elements are eliminated is dependent upon the amount of the limestone charged. Sulphur, however, is not so readily removed as is the phosphorus and hence in making a high purity iron it is necessary to use raw material as low as possible in sulphur.

The furnace, besides supplying heat, also supplies an air blast by which some of the impurities are oxidized out. This is further aided by adding iron ore in small quantities, not for the iron content, however, but for the oxygen content. After about eight hours in the furnace the material is ready from a steel manufacturer's standpoint and is tapped out of the furnace and cast into ingots. The analysis of this steel will run about as follows:

Sulphur .....	.05
Phosphorus .....	.09
Carbon .....	.10
Manganese .....	.45
Silicon .....	.04
Copper .....	.06

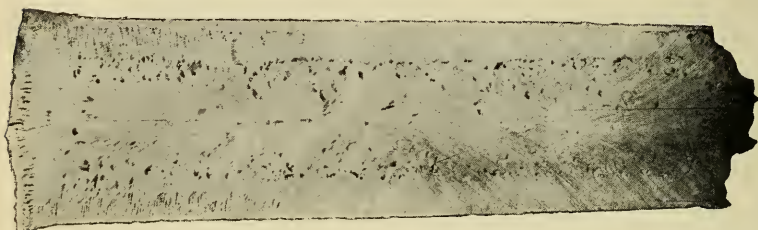
The temperature at which the steel manufacturer taps his heat is 2,700 degrees Fahrenheit.

The iron manufacturer does not tap his material out at this stage, but this is really where his work begins. He continues the oxidizing air blast and he continues adding iron ore from time to time until the impurities are eliminated to mere traces. Tests are taken from time to time in order to know definitely what the analysis is. The chemist must insist on the impurities being eliminated to a definite point before the heat is taken from the furnace. Frequently four or five tests are necessary to accomplish this, for the last traces of impurities are the most difficult to eliminate. It frequently requires an hour to reduce the manganese from .05 per cent to .025 per cent. As these impurities have been eliminated the temperature within the furnace has gradually raised until it is approximately 3,100 degrees, and this is very close to the melting point of the brick in the furnace. The average time required to make a heat of iron and to obtain this degree of purity is twelve hours, and the analysis will then show as follows:

Sulphur .....	.025
Phosphorus .....	.005
Carbon .....	.01
Manganese .....	.025
Silicon .....	.004

You will notice that the impurities here are very much lower than the steel analysis given above. The heat is then tapped. It is to be noted that we have removed the impurities by oxidization and as a result of that we have actually oxidized some of the iron. The next step is to eliminate the oxygen, and this is accomplished by the addition of aluminum. Oxygen has a stronger affinity for aluminum than it has for the iron itself and hence this eliminates the oxygen very thoroughly, this new combination of aluminum floating to the surface.

This heat of iron weighing approximately sixty tons is poured into ingots weighing approximately 5,000 pounds each. These are roughly 2 ft. in cross section and 6 ft. in height. I have spoken of the elimination of oxygen by the use of aluminum. Oxygen or other gases may occur in iron or steel in one of two forms. It may be chemically combined with the iron, in which case it will show on chemical analysis; or it may be thrown out of the chemical combination by appearing in the interior of these ingots in the form of gas holes or blow holes. This cannot be determined by the exterior appearance



Split Ingot of Carelessly Made Steel.



Split Ingot of Carefully Made Pure Iron.

of the ingot nor can it be determined by chemical analysis. It is necessary to follow this work carefully and to split open longitudinally frequent ingots in order to examine the interior structure. The views which I show point out plainly a properly and improperly degasified ingot. Such work as this necessitates careful, thorough and expensive research work, but it is necessary if we are to obtain the most rust resisting material possible. The presence of these blow holes makes a spongy condition, and a place where rust can and will start rapidly.

After the material has been cast into these ingots and the molds removed they are rolled first through the blooming mill,

then through the sheet mill down to the sheet form. It is necessary to exercise the greatest care possible in heating these ingots before rolling in order to attain the proper temperature without burning them. And it is necessary in rolling the material to shear or crop a sufficient amount from the top of each ingot to make certain that the remainder is only good, solid material. The conscientious manufacturer finds that he must crop very liberally, but he knows that that is necessary to obtain his final result—a rust resisting sheet.

During all of this time strains have become set up in these sheets and it is necessary to remove them by annealing. This is a process of slowly bringing the sheets to the annealing temperature and then just as gradually lowering that temperature. It requires five days to do this thoroughly. This does not change the chemical composition, but only the physical structure. It is, however, highly essential if a rust resisting sheet is desired. As the temperature is gradually brought up and then lowered it is carefully watched by means of an electric pyrometer in order to keep it absolutely under control. Too much stress cannot be laid upon this step. It must be taken slowly. It must be watched carefully and the manufacturer must not be tempted to increase his output and reduce his costs by hurrying this important step.

After leaving the annealing department the sheets or plates are thoroughly cleansed and washed, this being known as the pickling. They are then passed through a bath of molten zinc. Here is another important superiority of iron as compared with steel. Steel dissolves in molten spelter from three to five times as fast as iron. The result is that starting with the same zinc bath, a steel sheet because of its solubility contaminates the zinc with the steel itself and the final coating will not be nearly so pure zinc as the zinc in the bath. Pure iron on the other hand because of its much slower solubility in zinc will take on a galvanized coating of much higher purity. The value of a galvanized coating depends upon the purity of it, so that it is clear that a pure iron sheet or plate galvanized not only gives more durability in the base metal itself, but it takes on a protective coating of greater protection. During the development of pure iron a few years ago, it was found that copper was detrimental. Sheets were made containing various amounts of copper and service tests showed that the material with the larger amounts rusted more quickly under service conditions than the material with the lower copper content, and hence the

manufacturers fighting for durability determined that to turn out a material of greatest lasting qualities the copper content must be kept at a minimum.

Unfortunately, however, copper cannot be eliminated in an Open Hearth Furnace and it is also unfortunate that a great deal of the raw material that the iron maker has at his command contains relatively large amounts of copper. Therefore when it was definitely found a few years ago that copper must be kept at a minimum, it was necessary to use carefully selected raw material in order to get it as nearly copper free as possible. Extra precautions are taken by offering the laborers loading the furnaces a bonus for any copper that is found in the scrap. This gives them an incentive, and quite a little copper is kept out of the furnace by this procedure.

Summing the whole matter up, the production of pure iron on a commercial basis has been a big step in advance. It has given the world a very much needed material. It is not merely the fact that it is of higher purity, but it has set up a standard and makes possible clearer specifications for a material of rust resisting qualities. Up to a few years ago an architect or an engineer using sheet metal never inquired into its analysis. Now, however, since he has realized its importance, the chemical analysis and the galvanizing is carefully specified in order to get the best possible material. This pure iron has been subjected to the most severe conditions and the reports of failure have been remarkably few. It is not fair to assume however that pure iron carelessly made can have the greatest rust resisting qualities, for if an iron has a bad chemical analysis it is not possible to convert that by rolling into good material. But if an iron has a good chemical



analysis it is possible to make an inferior material of it by lack of care and lack of conscience in its working.

The manufacturer must be conscientious. He must have an inspection department so organized that the raw material is carefully inspected. That inspection department must reject any material having any defects whatever. Also the manufacturer of a rust resisting iron should have an organization so developed that their ideas and their standards are of quality and not quantity. Such an organization cannot be developed in a day, month or a year. It takes years to get this spirit down to the last man, and that is the only way in which results can be obtained. The standard of quality must ever be kept before them and every man must be on the alert to reject any material falling below that standard. But with the combination of these a material of greatest rust resisting qualities is obtained and a material which has given satisfaction to engineers and architects under the most severe conditions.

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

A SIMPLE METHOD OF SECURING DUSTLESS CONCRETE FLOORS

By P. M. BRUNER,
MEMBER OF THE ENGINEERS' CLUB OF ST. LOUIS.

[Read before the Club, March 17, 1915.]

As most of you know, there are still many cases where cement products fail in giving complete satisfaction. Defects in cement work are cropping up that cannot be accounted for, apparently, by any knowledge obtained so far in the scientific study of and experimentation with cement.

Portland cement concrete sidewalks, having a top-coat richer in cement than the concrete of the body of the blocks are giving such general satisfaction that this paving has displaced those of almost all other materials. Even for driveways and roadways, concrete is beginning to compete with other favored materials, and with good prospects of superseding all other materials where the traffic is not excessive. Under these circumstances it has been a puzzle to find out why the wearing surface or top-coat on reinforced concrete floors inside of buildings has given so scant satisfaction. The same composition for top-coating, giving satisfaction in the basement, often is worthless when applied to the reinforced concrete on the upper floors. In the last few years technical papers have been full of complaints and suggestions on this point. Under special and unusual conditions, good floors have *occasionally* been laid on reinforced concrete in the ordinary way. For this and other reasons, most experiments seeking to overcome the trouble have also been successful at times, and yet more often have been failures, thus leaving the faultiness unsolved and the cause hidden more completely by misdirection.

And here perhaps is the place to define faulty, or so-called "dusty" floors. All floors are dusty that wear at all, and in cities all floors are dusty whether they wear or do not wear; but in this latter case all of the dust comes from other sources than the floor itself. The dusty floor that confronts and concerns the concrete worker, is one where the fine sand or other aggregate ravel out or rolls out of its bedding under moderate rubbing, scratching, or rolling of wheels. This produces, incidentally, both the objectionable dust and grit.

Such continuous failures have naturally created a demand for correctives to be applied after the failure has occurred, or for

hardeners to be applied to the original composition to assist the cementing potency of the Portland cement sufficiently to avoid the failure. One corrective of a floor that is faulty, is the subsequent painting with ordinary paint, or with paint that has more or less varnish in it. These paints serve in part as a wearing cover, and in part as an agglutinating potency between the grains of sand. But it also prevents water from reaching the interior of the top-coat thereafter which otherwise might penetrate and aid in the hardening process in the course of time. Another corrective of a floor that is denominated "dusty" has found advocates. In this process the floor is rubbed or ground with a piece of grindstone, fastened to a handle, and assisted with some loose sand scattered over the surface of the floor. This work is so performed that the soft cement between the grains of sand on the upper surface of the floor is rubbed out without disturbing the grains of sand in their bedding. When almost the whole of the upper half of these grains of sand is exposed, the rubbing is discontinued and the spaces around the grains of sand are filled with pure cement which is ground in with the same rubbing instrument. This process may form a strong filling around the grains of sand, as also a very thin covering over the top of the grains of sand. This is good as far as it goes, and will enable a job to pass inspection that would not pass before. It adds, however, no strength to the weakened cement immediately below the middle of the grains of sand. On this account the trouble may return after the floor has had some service. Instead of remedying the faults of a finished floor, efforts have also been made to increase the cementing potency by adding so-called hardeners to the Portland cements. The active ingredients of most of these hardeners are chiefly finely pulverized iron and sal-ammonias, which are supposed to make between the grains of sand the old and well-known rust-joint, in conjunction with the Portland cement. The work done by us with these hardeners, under the instruction of their official specification, and under the advice of their superintendents, have failed to justify the claims made for the hardeners. Tests made for us by the Robert W. Hunt Company with and without hardeners, did not show any advantage for them. Under unusual conditions, as said before, good work has been done sometimes by the ordinary routine work, hence one may surmise that these hardeners have given satisfaction and have been credited with benefits due to other causes than their own inherent value.

According to my observations and experiments, I came to the conclusion that cement top-coating on reinforced concrete remains weak and deficient in strength because of the excess of water that is required to make the mortar plastic enough to be properly spread and struck off with a straight-edge. The stiffest mortar that can be worked contains 20 per cent more water than is required for the highest quality of concrete. A stiffer mixture than this will shove before the straight-edge in striking off or peel up immediately behind. This excess of water has no chance of escape downward, and rises toward the surface, where it remains until the setting process of the cement has well advanced. When a certain portion of the water has become bound in this way, in the setting process, the mortar stiffens up and becomes ready for the usual process of finishing and smoothing. Sometimes the setting goes forward too rapidly so that the finishing cannot be carried out without sprinkling even some more water over the top to enable the workmen to work out a smooth finish. It follows that the floor is finally finished only after a period of four to twelve hours after the composition was first made into a plastic mortar. Not only is the strength of such a floor injured by the excess of water bound and entangled in the pores of the mass, but also by the disturbance of the crystallization process.

The only feasible way to overcome the difficulties then seems to be that of withdrawing the excess of water that was necessary for the spreading and the rodding of this plastic mass to the desired level or grade of the finished floor. To bring this about, therefore, I lay on the plastic floor surface, when brought to its proper level, a webbing of some kind, and place over the same some dry material which quickly withdraws the excess of water by the capillary attraction of the dry material. This may take up 20 to 30 per cent of the water originally used in producing plasticity of the mortar. It will not take up more than this, however much dry material is applied, and the amount of water left in the mass corresponds quite well with the amount that a professional cement tester considers necessary in making proper test-pieces.

My surprise in my first experiment, in regard to the condition of the top-coating after the cloth was lifted off with its load of damp material, was great. It had become so hard or stiff, in twenty minutes after the dry material had been placed over it, that

one could walk over the surface without making even a heel-mark. In fact the coating was so dry and stiff that it required a powerful effort to float it with a wooden float to an even finish, that could be smoothed off with a trowel. This effort, however, forced the grains of sand so much closer together that in this way some moisture was forced upward from between the more compressed mass, so that the floor could be properly smoothed off. The time between the spreading of the mortar and the smoothing of the floor need not be more than thirty minutes. Without the use of this drying process, we have, as said before, found that it would require the expiration of from four to twelve hours before the work could be successfully brought to this stage.

What I claim for this process is: First, a harder and a denser top-coat; secondly, a wearing coat that is equal to the best work on sidewalks and, thirdly, the elimination of overtime work by an extra expenditure for labor of only one-tenth to one-fifth of a cent per square foot in laying a floor, and this extra expense is more than offset by the usual cost of overtime work. I do not claim to improve the cement, but I simply get out of it all the strength there is in it. If any hardener can be found that will increase the wear-resisting quality of Portland cement concrete, this process of mine will still be a profitable one inasmuch as it increases the density of the resulting cement topping, and enables the work to proceed without delay and without the need of overtime work. The process is even more desirable where the wearing coat is placed on the reinforced concrete soon after this has been poured. In this case there is still less chance to get rid of the excess of water downward, for the foundation itself in this case is saturated clear through the mass with the water used in making the concrete liquid for the pouring of the reinforced floor slabs.

It is perhaps also well to add that the top-coat placed over reinforced concrete should not be made too heavy. There is considerable difference in the expansion and contraction of the two mixtures under standard specifications. A medium thickness of top-coat will, therefore, more readily adjust itself to the reinforced concrete beneath. A heavy top-coat on the other hand may assert itself sufficiently to bring about a powerful shearing strain between the two, so that they will separate at the expense of the weaker mass. Specifications should not call for more than a $\frac{1}{2}$ -in. thickness, nor allow any where more than a maximum of

1-in. A top-coat of $\frac{1}{2}$ -in. thickness on sidewalks, subject to the heaviest traffic, will last more than twenty-five years. The top-coat should also not be made to correct irregularities of the surface on which it is placed. Those who lay the so-called Sanitary or Magnesiant cement floors will not undertake to lay a greater thickness than $\frac{3}{8}$ to $\frac{1}{2}$ -in. thickness because this material expands still more than any Portland cement concrete. Because Portland cement topping demonstrates this fact less clearly, it is applied in thicknesses up to $1\frac{1}{2}$ -in. and 2-in. The reinforced concrete contractor can, if he will, obtain a levelness that will require no extravagant thickness of topping. He can also construct this floor so that there will be no laitance on it. This laitance is a soft chalk-like mass that forms frequently on top of poured concrete and has not sufficient strength to hold topping or even the concrete beneath.

We do not claim that our drying or dessicating process is the only thing that is required to make a dustless floor. We claim that it is the most important element of certainty of success. We are at the same time much more thorough, than has hitherto been the case, in the preparation of the foundation on which the topping is spread and in all of the details of the construction as a whole. This has been observed wherever we have done work. Our construction is not more expensive because of the special feature of the drying process, as has been stated above, but because of work wholly omitted by others or less thoroughly done. We do not make the matter of cheapness our motto, but that of service. We guarantee our work and do the work in a way that the guarantee may not become burdensome. A floor costing perhaps less per square foot is not a cheap floor when it has to be filled with linseed oil or a liquid varnish preparation, or a solution of water-glass. Besides, no oil or varnish preparation can ever take the place of first-class Portland cement concrete. No one would suggest an oil or varnish concrete for the original floor. Such preparations may palliate an acknowledged failure, they cannot supersede the Portland cement concrete.

DISCUSSION.

MR. A. P. GREENSFELDER. Mr. Bruner said something about laitance. How do you avoid or remove it?

MR. BRUNER. The first step to avoid it is not to get the liquid too liquid. The next step is not to poke it too much. Get it in

its proper place with the least movement, because laitance is nothing but drowned cement. The best and finest cement goes to the top and the heavy stones sink down to the wooden forms. The cement on top combines with the excess of water, and when this laitance has become apparently dry it contains 25 per cent of water bound in, and it is often so soft that you can scrape it with a finger-nail or cut it easily with a knife; so the way to do is not to make the concrete too wet or poke it too much.

MR. S. B. RUSSELL. Is the amount of laitance affected by the quality of the water? Do you know whether hard or soft water makes any difference?

MR. BRUNER. I think it is always a matter of gravity. You take a wheelbarrow full of mixed top-mixture and wheel it a hundred feet and you will find that some of the sand has gone down to the bottom and the water and some of the cement has worked its way up to the top. You have then a lot of fine material and water on the top of the load.

MR. GREENSFELDER. Were the floors you mentioned put on a hardened floor, that is, laid some days before the top was put on?

MR. BRUNER. All our work has been done after the floor had hardened.

MR. GREENSFELDER. Were they only one-half inch thick?

MR. BRUNER. No, we have often put on a thickness as much as one and one-half inches, because we expect to make a level job and we have either to do this at our own expense or that of the builders; but the topping should not be more than three-quarters of an inch thick on the average.

At the Union Station, in the midway, there is some work that is down now nearly twenty-five years and you will find it as slick as glass. It will be good for 100 years or more at the rate it is wearing.

MR. F. C. WOERMANN. Do you find that granite screenings increase the hardness, or is it the cement entirely that gives the topping its wearing qualities?

MR. BRUNER. I know that granite makes a stronger concrete than sand. I would not be sure in saying that it wears better, but if you make a piece of top-coat one-half inch thick or one inch thick, half and half, that is, one part cement and one part granite, and another piece the same thickness of one part ce-

ment and one part sand, I think one will wear pretty near as well as the other, but if you let both thoroughly harden and hit each with a hammer, you will find that the granite will stand three blows to one that the sand will stand. Granite concrete holds together better, but it does not wear much better. I believe that Meramec sand will stand more grinding friction or wear than granite will.

Mr. ————. I would like to know what that drier is which you used on top of the cloth?

MR. BRUNER. It is the same kind of material that we use for the top-coat, except that we use it dry. It is top-coating without any water in it. When it is taken off it is of course damp and is at once taken back to the mixing box and made into the next batch of plastic top-coating.

MR. J. W. WOERMANN. It has the sand mixed with it ready for the water?

MR. BRUNER. Yes, sir.

MR. G. R. WADLEIGH. You might be interested to get some more details about the work that Mr. Bruner just spoke of which happened to be in one of our buildings. The first building he spoke of was built in 1910 and we had some very unsatisfactory floors put down in what we thought was the most approved manner; that is, the topping was put on before the floors themselves had set. We had the usual trouble with rainy season and men working at night, and got floors that not only dusted, but were more or less pitted. When we came to put up the second building about a year and a half later, the question of floors came up again, and the management of the company was so dissatisfied with the floors just mentioned that it was almost settled that we would use maple tops on the concrete. About that time we heard that Mr. Bruner was willing to undertake a topping, put on after the base was set and guarantee it. I saw a building in Kansas City in which they seemed to be putting in pretty successful floors after the base had set, so a contract was let to Mr. Bruner with the very successful results which he has mentioned. Very modestly, he did not mention the fact that in taking up parts that became loose it was found that about 90 per cent of the loose parts had become so, not through any fault of his work, but through inferior concrete below. In other words, his topping pulled apart the concrete below and showed that

its bond was better than the original concrete in every way. We have something like 400,000 square feet of concrete floors in different buildings and his are by far the best of any we have.

MR. BRUNER. The error to which Mr. Wadleigh refers was ours, but we did not know it at the time. We should have picked off all the soft concrete that came up later. That is the only way to make sure of success. I want to tell you engineers that with a floor supposed to be 6 or 8 inches thick and put in with proper reinforcements, you want to make sure that the upper half-inch or the upper one inch is really dependable concrete. If it is of the kind Mr. Wadleigh mentioned, your floor is not 6 or 8 inches thick, and your neutral axis is not where you think it is.

MR. S. W. BOWEN. I would like to ask Mr. Bruner if he has applied this method to sidewalks.

MR. BRUNER. It is not necessary. There we put in the bottom material with less water and at once put the top on the fresh concrete and the water can go downward in this case.

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

REINFORCED CONCRETE COLUMN FORMULAE

DISCUSSION.

[Volume 54, page 94, February, 1915.]

MR. CARL GAYLOR. The so-called Considère formula for reinforced concrete columns, i. e., any formula which includes the steel of the hooping in the effective area of the steel reinforcement, is so generally used in the municipal building codes of our large cities, that our reason for abandoning said formula should, in my judgment, be supported by stronger arguments than are given in the report.

Hooping is used, primarily, to prevent lateral deformation of the steel longitudinals. It serves the same purpose as the lacing of a steel column. Like in the case of the latter, there is no theory by which it can be proportioned; the selection of the size and pitch of the hooping is a matter of judgment and experience assisted by such large-sized tests as may be available. If the hooping holds the longitudinals securely in their position until their full strength under maximum loading is developed, it has done its duty—it has been fully efficient. Such, at least, is my opinion and presumably that of the other members of your Committee likewise.

Now according to the Considère formula additional strength of the column is obtained by a further increase of the size of the hooping bars and a reduction of their pitch beyond the efficiency just described.

To illustrate this:

The safe load on a column of 20-in. core-diameter, 4 per cent vertical steel and $\frac{3}{8}$ -in. hooping with 4-in. pitch is, under our present building laws, 245 tons. The same column, but with $\frac{1}{2}$ -in. hooping and 3-in. pitch, would safely carry 303 tons; i. e., we are expected to believe that by a mere doubling of the hooping, the strength of such a column is increased by 58 tons, or 24 per cent.

But we do not need such figures. It is a fact thoroughly established in reinforced concrete construction that the benefit of hooping comes into effect *after* the loading of the column has exceeded its working strength. This point has been well brought out in the report and should dispose of the merits of the Considère formula.

There is another and more important reason for changing the present column formula of our city.

Building laws need not, necessarily, be strictly logical or scientifically correct, no more than criminal laws need be teachings in "Higher Ethics;" but what we must insist on is that they ensure safety.

Of all reinforced concrete members in a building, the column is under a disadvantage, inasmuch as the filling of the forms with concrete is a more delicate matter than with a girder or a slab. The numerous failures of reinforced concrete buildings have also generally been traced back to the failure of one or more of the columns. The use of such excessive stresses as are allowed in our building code—20,000 lbs. per sq. in. in the longitudinals, and 48,000 lbs. per sq. in. in the hooping—seems utterly unjustifiable.

About a year ago a paper read before the Western Society of Engineers by Mr. T. L. Condon gave a list of allowable loads under the building codes of a number of cities, which is as follows.

The list is for 1:2:4 columns, 20-in. diameter of core, 4 per cent vertical steel and 1 per cent hooping.

	Tons.
Philadelphia } -----	157
Indianapolis } -----	
Detroit -----	159
Joint Committee -----	160
New York -----	164
Chicago -----	169
Baltimore -----	189
Cleveland } -----	196
Milwaukee } -----	
Columbus -----	226
Minneapolis -----	236
St. Louis } -----	276
Pittsburgh } -----	

Of the twelve cities enumerated, St. Louis, with Pittsburgh, allows the highest loading, about 60 per cent more than Chicago, and 70 per cent more than New York.

The formula proposed in our report gives for the same column a safe load of 188 tons, which seems like a fair average.

MR. A. J. WIDMER. I do not know what the program is in connection with this report. If it is the idea to vote and endorse this report as a whole, or to endorse parts of it, I think that should be deferred until we have had more time to digest the report. The Committee took two years to make it up and we have had it for consideration for a few weeks.

I am sorry the Committee did not have before them some very recent tests on hooped columns. I have just received and have here the February number of the Journal of the American Concrete Institute, which describes tests made in the latter part of 1913, reported on by a special committee of this Association at the annual meeting in February. I have not had time to study this report, but wish to read some of the conclusions of the Committee.

1. "The tests indicate that columns with spiral reinforcement are stronger and tougher than columns with longitudinal reinforcement."

2. "From these tests it would appear that the spiral reinforcement is approximately four times as effective in giving ultimate strength to the column as the same volume of longitudinal reinforcement."

These two conclusions are apparently similar to the conclusions drawn by other investigators, but the final conclusion is somewhat startling.

3. "It appears that the effect of the longitudinal steel reinforcement decreases as the percentage of spiral reinforcement increases."

I cannot call to mind that this point has ever been brought out before by tests on spiral columns. In hurriedly reading over the body of the Committee's report, the idea I gathered is that after the column has passed a certain load the tendency of the verticals to buckle where attached to the spirals or very close to them throws such an added stress into the spirals as to rupture same and, of course, when the spiral is broken, the column is done.

MR. GAYLOR. What was the size of those test pieces you spoke of?

MR. WIDMER. Here are some, 1-ft., 8 $\frac{3}{4}$ -in.; 1-ft., 8 $\frac{3}{4}$ -in.;

1-ft., 8-in.; 2-ft.; 1-ft., $8\frac{3}{4}$ -in. They all seem to run about that size.

I have some criticisms to make on the proposed code. The column indicated, as I have it, is a 20-in. core, 1 per cent hooping and 4 per cent vertical steel. I do not think a designer could win a job with that column. In other words, I do not think it is commercially the most economical column to carry a given load. Under competitive conditions here in St. Louis, to carry a 188-ton load, you could present a cheaper column by making it a little bit larger,—perhaps by keeping the same percentage of hooping and by putting in considerably less vertical steel.

I raise this point of economy in design in the column shown because it seems to me that if a larger column with less vertical steel were used to compare the safe loads allowed by various building codes, the results would not differ as widely as in the column selected by Mr. Gaylor. I actually find in designing columns under competitive conditions that the present code on spiral columns gives total safe loads only about 5 per cent over those obtained by using Considère's formula with a base of 750 lbs. This point is important because similar columns designed by the proposed code will give much lower total loads.

Another thing about the proposed code. I think that every engineer feels a hooped or spiral column is very much better than a rodded or banded column, and whatever is suggested in the way of a new code, as far as spiral columns is concerned, should be something that will tend to increase the use of them and to discourage the rodded column.

Perhaps the worst thing, from a commercial standpoint in this recommendation of the Committee, to my mind, is the requirement that all the vertical rods be tied at every third intersection. In the first place, as I remember it, the minimum number of rods is six. I want to cite a case of a building going up now. There are 36 columns on one floor, and I think they are about 20 ft. high. The pitch averages about 2 in., which under the proposed code would mean that you would have about 8,600 ties to make before you would have those columns ready to put in place in the forms. I do not think any designer could convince a contractor that spiral columns are economical under those conditions, so I think that alone by this one clause

regarding tying vertical bars we do away with the very thing the proposed code is supposed to do or should do; that is, instead of encouraging spiral columns, we would by this requirement discourage their use. It would be impossible to use in competition a spiral column under such requirements as to tying vertical bars. A banded column would always be cheaper.

There is another point. If you take the minimum proposed requirement of 1 per cent of vertical steel, you have an average stress in your steel and your concrete together of $862\frac{1}{2}$ pounds per square inch of core. The elastic limit of these columns, according to Withey's table, I think, is about 2,500 pounds. With the maximum amount of vertical steel, you have approximately 1,200 pounds average on the core. The elastic limit in Withey's table is about 3,500 pounds, so it is evident that the Committee has taken a factor of safety of about three. Now I think in designing a column it ought to be borne in mind that, as I said before, the commercial designer ordinarily does not use a spiral column unless his load is large and he either has to keep the size of column within certain requirements for architectural reasons or because of economy in concrete and forms. Therefore, it is unlikely the spiral column will be used except in the lower floors of a building where there are several floors supported on the first spiral column, or where you have a very heavy floor load. Now, under either one of these conditions, it is practically impossible to overload the column. The question might come up of voids in the column. Referring to the sketch Mr. Gaylor made on the board of a large column with an 18-in. pocket in it, I do not think that any formula you could devise for a spiral column would make such a column safe. In other words, if you are going to have a big void like that the column is going to fail no matter how it is designed, so, all these points considered, I think one would be perfectly justified in using a less factor of safety than three on spiral columns. According to our code, we now use a less factor of safety than three on slabs and beams in extreme fibre stress in concrete in bending. If this is good practice on slabs and beams, which especially for light loads can easily be overloaded, then if spiral columns are only to be used for heavy loads, where there is practically no chance of overloading them compared with the chance

there is on a particular slab or girder, why are we not justified in using a smaller factor of safety? If we do use a lower factor of safety, it will tend to make our buildings not less safe but more safe, because it will then make the spiral column more economical to construct than a large rodged or banded column. In other words, the designer will probably begin to hoop his columns at the eighth floor of a building instead of at the sixth floor, so we will have a higher percentage of spiral columns and safer columns in a given building.

There is another thing that I think has not been considered, since the report makes no mention of it, and that is the question of fireproofing. The February bulletin of the American Concrete Institute gives a report by the special committee on the Edison fire. Their report shows how the columns were affected. I do not know how many have seen the sketch on page 102, but it shows four typical ways in which columns were affected. In all cases the concrete has spalled off the corners.

The present code requires a minimum of 2 in. of fireproofing on both round and square spiral columns. I think this is too much. The action of the columns in the Edison fire confirms previous experience that the damage to a square column by fire is at the corner, and, further, that surfaces without projecting corners are comparatively little affected by fire. This being the case, I wish to make two points—one in connection with round columns, the other regarding square columns, both spirally hooped. In the round column there are no projecting corners and the damage by fire will probably not extend more than one-half inch into the shell. In the case of a square column with a minimum of 2 in. of fireproofing, this 2 in. naturally occurs at the center of the side, and at the corner we have not 2 in. but 5 in. of fireproofing for a 12-in. column and 9½ in. of fireproofing for a 36-in. column. This is an enormous waste of material and it is evident on the face of it, if the damage to the square column is at the corner, we are then justified in decreasing the fireproofing at the center of the side. I would recommend that for columns, both round and square, the exterior diameter be 3 in. greater than the core diameter.

In this discussion I have referred frequently to competitive designing. It seems evident that if we can make our requirements for spiral columns not only safe, but also economical,

we will not have to urge the use of the spiral column, because the competitive designer, who is a considerable factor in building construction, will not have to be forced to use spiral columns, but will use them because they are economical and this will be real advance in construction. My point is, it will be easier to induce designers to use a greater percentage of spiral columns if the cost of this column compares more favorably with that of the ordinary banded column.

MR. A. P. GREENSFELDER. I think the points brought out by Mr. Widmer are very well worth considering.

MR. WIDMER. I think the main thing is that we ought to have more time to think and talk over the report of the Committee.

MR. HENRI RUSCH. I have seen quite a number of columns constructed in this city, in fact, for the last ten years I have paid particular attention to them, and I must say that not only have we not had any serious mishaps, but the work has progressed smoothly. There were few defects and no failures whatever. Looking at the table prepared by Mr. Gaylor I notice several cities which have low stresses in their reinforced concrete columns and yet at the same time I have read and you have read of several terrible accidents happening in some of those cities where buildings collapsed because the columns gave way. Now, I think that we have been very fortunate with our column formula which gives such high stresses in comparison with other cities which have much lower column stresses, when you note at the same time that they have not been as fortunate as we have been. If this formula should be revised full credit should be given to the spiral hooping, and the value of spiral hooping should stand just where it is now, except that the stresses on the concrete and on the vertical steel rods should be placed, say, at 800 lbs. on the concrete and on the vertical steel at 12,000 lbs. instead of 20,000 lbs. per sq. in. as we have it. With this revision I believe the column formula should stand just as it is. Another reason why I think it should be that way is, as Mr. Widmer brought out, for architectural reasons it is often desirable to have small columns, and if we would adopt the formula Mr. Gaylor proposes, I do believe that reinforced concrete construction for some buildings would be abandoned altogether and steel construction be adopted which, I think,

would be a step backwards. In other words, for buildings, say, 10 stories high to be used as warehouses with fairly large panels, we might find that under the proposed new formula we would require such enormous columns that the owners would not consider such construction at all but go back to steel construction.

Another point to be considered is this: In the calculations for the ordinary hooped column the outside 1 in. is neglected and assumed as fireproofing; the rest is considered as carrying loads at 500 lbs. per sq. in. In spiral hooped columns the outer 2 in. are neglected, therefore a spiral hooped column of the same diameter as a plain hooped column, if proportioned according to the proposed new column formula, is supposed not to carry much more than an ordinary hooped column, and that would be a great mistake, I should say. I have investigated the value of spiral hooping for columns and I am very much in favor of putting a good value on spiral hooping. I cannot understand why Mr. Gaylor should recommend that the carrying capacity of spiral hooped columns should be reduced so much and, for my part, with the experience that I have been able to gather in this city, will say that I am for the old formula revised in a moderate way.

MR. GAYLOR. Did you say that you were in favor of allowing 800 lbs. on the concrete and 12,000 lbs. on the steel?

MR. RUSCH. Yes. The full value of the spiral hooping should be added to this. The spiral hooping stressed at 20,000 lbs. as in the present formulae.

MR. C. W. MARTIN. It may be remarked that, as is quite natural in considering a matter of this sort, your Committee were not all of one accord relative to form and substance of the report. We were though, I think, all agreed that a formula which specified a minimum amount of helical hooping and which took the efficiency of the helical hooping into account by allowing a higher unit in the concrete enclosed was a good form of regulation for a building code. Further, we were, I think, all agreed that, say $\frac{3}{4}$ or 1 per cent of hooping would provide sufficient lateral reinforcement for columns designed on a safe working load basis.

Mr. Rusch mentions the fact that columns designed under the present St. Louis regulation do not fail while those in other cities designed for considerably lighter loads often do.

That speaks well for the supervision given the work by the building department and also for the workmanship of our contractors. Both are essential in successful concrete construction. The lack of one or the other or both may be a more cardinal factor in the general run of failures than the units employed in design.

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

PILE DRIVING WITH AND WITHOUT THE WATER JET

By F. Y. PARKER,

MEMBER OF THE ENGINEERS' CLUB OF ST. LOUIS.

During the working season of 1914, careful observations were taken to determine the behavior of wood piles driven under various conditions in dike construction, along the Mississippi River.

These dikes were slightly oblique to the current and consisted of three rows of pile clumps (the clumps of each row staggered with respect to the other rows) braced with stringers. The piles of each clump were drawn together and cabled at the head; and overlapping stringers were forced between adjacent rows of clumps and securely fastened thereto.

The clumps of each row were between nine and ten feet distant; the rows between 4 and 5 feet apart, and the individual piles of each clump, at the point of soil penetration, about four feet apart.

Although some mud, ordinary sand and gravel were encountered, the predominating soil of penetration was very fine sand.

Drop-hammers weighing 2,400 pounds each, with 400-pound Casgrain pile caps, and 7,000 pounds single steam-hammers (ram 5,000 pounds) were used in the work of driving nearly 4,000 piles.

The steam-hammers could deliver 60 strokes per minute, but in practice this maximum was rarely approached on account of the danger of breaking the pile. It was found that, with the exception of small piles, a delivery of 45 to 50 blows per minute allowed the pile to recover; large straight timber permitted the maximum number of blows to be given while small sticks could only be struck 35 to 40 blows per minute.

Drop-hammer lines were directly attached to the hammer; the slight reduction of hammer momentum was considered of less importance than ease of manipulation.

The jet-pumps on the steam hammer drivers were Gordon duplex 10x6x10-inch stroke; those on the drop-hammer drivers were Hooker 12x7x16-inch stroke. Each of these pumps approximated a pressure of 60 to 65 lbs. at a distance of 100 feet from the pump.

A single 2½-inch iron pipe, coupled in sections, with the end section reduced to a 1¼-inch nozzle, was used in jetting. Con-

nection was made between the jet pipe and a stationary pipe, leading from the pump to the leads, by a rubber hose.

While neither pile rings nor shoes were used, pile pointings, of various shapes and dimensions, were tested, as indicated in the headings of the following tables.

After the pile had penetrated several feet, driving was suspended until the jet pipe could be placed in position against the pile and the bottom. Jetting and driving were resumed simultaneously and were continued until the desired penetration was secured.

Whenever the jet failed to reduce the pile friction, the jet pipe was withdrawn and relocated against the pile. Sometimes several relocations failed to bring results; at other times the pile, plus the weight of the hammer, would drop several feet—(see Tables No. 1 and No. 10)—or have a decided drop under single blows—(see Table No. 8).

Conclusions.

From recorded and personal observations the following conclusions were deducted:

1:—When the water-jet was not used, compacting of the soil occurred at the clumps.

2:—By the use of a water-jet, of sufficient nozzle pressure, piles of any size and condition can be quickly sunk with practically no assistance from the hammer. The possibilities, in this direction, are shown in Table No. 5.

3:—For the best results, the pile should be kept parallel to the leads with the jet nozzle in line and a few feet below the pile foot.

4:—Apparently, chisel pointings are the best for driving; they also require less labor in preparing.

5:—Fine sands give the most pronounced and uncertain irregularities in penetration.

6:—Instances where the water-jet was apparently unsatisfactory, proved to be due to one or both of two causes,—insufficient nozzle pressure or divergence of the jet pipe from the pile. The result of a well located jet pipe and the effect of later divergence is shown in Table No. 6.

7:—For ordinary timber and soils, the writer suggests a 3,000-lb. double acting steam hammer in conjunction with a single pipe water-jet,—minimum nozzle pressure 175 lbs. :—with this

combination the use of the hammer would be confined, in a large number of piles, to a few blows at the beginning and end of each operation.

Explanation of Tables.

Recorded observations were taken on the behavior of 169 piles, of which the following twelve are representative.

Some of the tabular nomenclature may need explanation:

"Butt down;" "Tip down;" indicate which end was driven into the ground.

"Tip flat;" "Butt pointed;" indicate condition of the end driven into the ground; squared normal to the pile and pencil-pointed, respectively.

"Blows;" "Drop;" "Penetration;" mean that of the number of blows, given in connection with drop and penetration, each separate blow fell the total number of feet recorded under drop and the total number of blows produced the penetration given.

"Bowed;" indicates a continuous bend from tip to butt with the maximum divergence given by the figure, following.

"Crooked" piles have one or more irregularities in their trunks.

"Curved" piles have a short bow somewhere in their length.

"Driving time" was the actual time the hammer was in motion; while "Extraneous time" represents the time consumed, between first and last blow, in clearing lines, relocating the jet and other necessary work.

DROP HAMMER TESTS

WITHOUT JET.				WITH JET.			
No. 1—Straight—15 Knots.				No. 2—Straight—30 Knots.			
Shagbark Hickory, 26'x11"x6".				Shagbark Hickory, 40'x14"x8"			
Butt, 4"x4"—down.				Tip, 8"x4"—down.			
Blows	Drop	Penetration		Blows	Drop	Penetration	
....	....'	3.0'	Water	....	....'	11.0'	Water
5	8'	3.0'	Sand	4	6'	1.0'	Sand
5	8'	1.6'	"	3	6'	0.9'	"
2	9'	0.5'	"	3	8'	0.9'	"
3	9'	0.4'	"	8	9'	1.2'	"
4	10'	0.7'	"	8	9'	1.0'	"
5	9'	1.3'	"	3	6'	0.3'	"
5	10'	0.7'	"	3	8'	0.6'	"
5	11'	0.8'	"	3	9'	0.4'	"
5	12'	1.1'	"	3	11'	0.4'	"
5	12'	1.1'	"	6	12'	1.0'	"
5	13'	0.4'	"	1	13'	0.4'	"
5	14'	0.5'	"	JET.	Jet Relocated		
10	14'	1.2'	"				
10	14'	1.1'	"				
10	14'	1.0'	"				
2	14'	0.2'	"				
5	14'	0.4'	"				
5	16'	0.4'	"				
10	16'	0.6'	"				
5	16'	0.5'	"				
10	17'	0.6'	"				
121	....'	18.1'	Soil	57	....'	21.5'	Soil
Driving time, 8½ min.				Driving time, 4.0 min.			
Extraneous time, 4½ min.				Extraneous time, 13.0 min.			

DROP HAMMER TESTS

WITHOUT JET.

No. 3—Straight—20 Knots.

Red Oak, 38'x17"x13"

Tip, 13"x3"—down.

Blows Drop Penetration

....	....'	11.5'	Water
4	4'	2.7'	Fine
4	5'	1.2'	Sand
4	7'	1.5'	"
2	8'	0.4'	"
3	6'	0.6'	"
3	7'	0.5'	"
3	9'	0.5'	"
3	10'	0.9'	"
3	10'	1.1'	"
3	11'	1.2'	"
4	12'	1.2'	"
3	12'	0.9'	"
3	14'	1.1'	"
3	15'	0.7'	"
3	15'	0.5'	"
3	16'	0.9'	"
4	17'	1.7'	"
3	18'	0.6'	"
3	18'	0.3'	"
9	18'	0.6'	"
3	18'	0.4'	"
3	20'	0.4'	"
3	21'	0.5'	"
3	22'	0.2'	"
3	20'	0.2'	"
3	22'	0.1'	"
9	22'	0.9'	"
9	22'	0.6'	"
2	22'	0.1'	"
108	....'	22.5'	"

Driving time, 11 min.

Extraneous time, 12 min.

WITH JET.

No. 4—Bowed, 6"—No Knots.

Sycamore, 35'x12½"x9¼"

Butt, 5"x5"—down.

Blows Drop Penetration

....	....'	9.0'	Water
5	10'	1.9'	Sand
5	10'	1.1'	"
1	10'	0.3'	"
5	10'	1.3'	"
4	10'	1.0'	"
3	10'	1.8'	"
2	10'	2.9'	"
2	10'	0.7'	"
5	13'	2.1'	"
2	13'	0.9'	"
3	14'	1.1'	"
3	14'	1.0'	"
2	9'	0.3'	"
2	15'	0.5'	"
2	16'	0.4'	"
3	16'	0.7'	"
3	19'	0.5'	"
3	19'	0.5'	"
55	....'	19.0'	Soil

JET.

Driving time, 6.0 min.

Extraneous time, 9.0 min.

DROP HAMMER TESTS

WELL LOCATED JET.

No. 5—Straight—Many Knots.

Red Oak, 40'x13.5''x7''.

Tip—flat—down.

Blows	Drop	Penetration	
----	----	12.0'	Water
3	8'	1.2'	Sand
3	8'	1.3'	"
3	9'	0.4'	"
3	10'	0.3'	"
3	8'	0.3'	"
3	8'	0.5'	"
3	7'	0.4'	"
3	8'	0.4'	"
0	0'	13.9'	"
3	5'	0.8'	"
3	7'	0.7'	"
30	----	20.2'	"

Driving time, 5/6 min.

Extraneous time, 12 min.

WELL LOCATED JET WITH
LATER DIVERGENCE.

No. 6—Bowed, 6''—5 Knots.

Red Oak, 38'x16''x8''.

Tip, 8''x4''—down.

Blows	Drop	Penetration	
....	....'	13.0'	Water
1	6'	0.7'	Quick-
3	9'	0.8'	Sand
3	11'	0.6'	"
3	12'	0.8'	"
1	13'	0.3'	"
3	9'	1.0'	"
3	9'	0.9'	"
3	8'	0.8'	"
1	8'	0.2'	"
0	0'	1.8'	"
2	8'	0.8'	"
0	0'	2.0'	"
2	6'	0.5'	"
0	0'	1.8'	"
2	8'	2.8'	"
1	8'	0.2'	"
3	6'	1.1'	"
2	18'	0.3'	"
2	20'	0.4'	"
2	21'	0.2'	"
4	21'	0.6'	"
4	22'	0.4'	"
45	....'	19.0'	Soil

Driving time, 4.0 min.

Extraneous time, 7.0 min.

STEAM HAMMER TESTS

WITHOUT JET.

No. 7—Crooked—8 Knots.

Cottonwood, 30'x12"x7".

Tip, 7"x3"x—down.

5,000 lb. Hammer. Drop, 2¾'.

Blows	Penetration	
----	5.0'	Water
3	1.4'	Sand
5	1.5'	"
5	2.0'	"
5	0.6'	"
10	1.5'	"
10	1.0'	"
10	1.0'	"
10	0.7'	"
10	0.8'	"
10	0.7'	"
10	0.5'	"
10	0.7'	"
10	1.0'	"
10	0.8'	"
20	1.2'	"
10	0.7'	"
10	0.5'	"
10	0.6'	"
10	0.7'	"
20	1.2'	"
20	1.2'	"
10	0.5'	"
10	0.5'	"
10	0.4'	"
20	1.0'	"
11	0.4'	"
279	23.1'	Soil

Driving time, 6.0 min.

Extraneous time, 6½ min.

WITH JET.

No. 8—Straight—No Knots.

Cottonwood, 41'x14"x11½".

Tip—flat—down.

5,000 lb. Hammer. Drop, 2½'.

Blows	Penetration	
----	7.0'	Water
10	6.6'	Mud
10	0.8'	"
10	1.1'	"
5	0.6'	"
10	1.2'	"
6	0.7'	"
		Jet relocated
1	5.2'	"
5	0.8'	"
10	0.7'	"
10	1.0'	"
4	0.3'	"
		Jet relocated
1	1.7'	"
10	1.1'	"
10	1.1'	"
10	0.7'	"
10	0.8'	"
10	0.4'	"
20	1.0'	"
10	0.4'	"
10	0.5'	"
4	0.2'	"
176	26.9'	Soil

Driving time, 3 5/6 min.

Extraneous time, 10 1/6 min.

STEAM HAMMER TESTS

WITHOUT JET.			WITH JET.		
No. 9—Crooked—6 Knots.			No. 10—Straight—No Knots.		
Sycamore—40'x12"x9".			Red Oak, 41'x15"x8".		
Tip—flat—down.			Butt, 5"x5"—down.		
5,000 lb. Hammer. Drop, 2½'.			5,000 lb. Hammer. Drop, 2¾'.		
Blows	Penetration		Blows	Penetration	
----	14.5'	Water	----	17.0'	Water
5	1.2'	Mud	5	0.5'	Sand
5	1.3'	Sand	10	1.4'	"
5	1.6'	"	5	0.3'	"
5	1.1'	"	15	0.6'	"
10	1.6'	"	2	0.1'	"
5	0.5'	"	5	0.4'	"
5	0.6'	"	5	1.2'	"
10	0.8'	"	5	0.4'	"
5	0.5'	"	5	1.6'	"
5	0.7'	"			Jet relocated
10	1.0'	"	0	5.0'	"
15	0.9'	"	5	1.7'	"
10	0.6'	"	5	1.1'	"
5	0.1'	"	5	0.9'	"
10	0.6'	"	10	0.8'	"
10	0.5'	"	10	0.6'	"
20	0.6'	"	10	0.4'	"
10	0.4'	"	5	0.3'	"
20	0.6'	"	5	0.2'	"
10	0.2'	"	5	0.3'	"
30	0.9'	"	10	0.8'	"
30	0.9'	"	15	1.2'	"
20	0.6'	"	5	0.2'	"
10	0.2'	"	6	0.2'	"
10	0.3'	"			
2	0.1'	"	153	20.2'	Soil
282	18.4'	Soil	Driving time, 7 2/3 min.		
Driving time, 5¼ min.			Extraneous time, 12½ min.		
Extraneous time, 8¼ min.					

STEAM HAMMER TESTS

WITHOUT JET.			WITH JET.		
No. 11—Curved—No Knots.			No. 12—Bowed, 8"—No Knots.		
Cottonwood, 29'x12"x7½".			Cypress, 40'x13"x8".		
Tip, 7½"x3"—down.			Tip—flat—down.		
5,000 lb. Hammer. Drop, 2¾'.			5,000 lb. Hammer. Drop, 2¾'.		
Blows	Penetration		Blows	Penetration	
....	5.0'	Water	....	11.0'	Water
10	4.4'	Sand	5	1.6'	Mud
10	2.0'	"	5	1.3'	"
10	1.4'	"	5	1.2'	"
10	1.2'	"	5	0.9'	"
10	0.9'	"	5	1.0'	"
20	1.6'	"	5	1.5'	"
20	1.2'	"	5	3.2'	"
10	0.8'	"	5	1.1'	Sand
30	1.5'	"	5	0.5'	"
10	0.4'	"	2	0.2'	"
10	0.5'	"	5	0.5'	"
20	0.8'	"	5	0.3'	"
10	0.5'	"	15	1.2'	"
10	0.4'	"	5	0.6'	"
10	0.3'	"	10	1.0'	"
20	0.8'	"	5	0.6'	"
10	0.3'	"	15	1.2'	"
10	0.4'	"	10	0.6'	"
10	0.3'	"	5	0.4'	"
20	0.6'	"	15	0.9'	"
10	0.4'	"	5	0.2'	"
30	0.6'	"	5	0.3'	"
20	0.6'	"	5	0.2'	"
20	0.4'	"	10	0.5'	"
12	0.2'	"	10	0.2'	"
362	22.5'	Soil	10	0.5'	"
			4	0.1'	"
Driving time, 8 2/3 min.			186	21.8'	Soil
Extraneous time, 7¾ min.			Driving time, 4½ min.		
			Extraneous time, 7½ min.		

BETTER ESTIMATING AND CONTRACT METHODS
As Advocated by The American Institute of Quantity Engineers

By G. ALEXANDER WRIGHT, TREASURER.*

If you are favorably inclined towards the movement in aid of "Better Estimating and Contract Methods" the opportunity is offered to you to become a Member of this organization.

The present movement, which originated in San Francisco in 1891, has always been a voluntary one, purely. It is not conducted for profit, but solely to encourage better methods and higher ideals in carrying out Building and Construction Contracts, thereby benefiting Owner, Architect, Contractor and Engineer.

This movement has now extended all over the country solely through voluntary service. No one is paid (except the printers and Uncle Sam). If everyone interested will now do a little, in place of one individual bearing the burden, even more efficient and speedy work can be accomplished.

The annual dues are one dollar, and a year's subscription to *The Quantity Surveyor* is one dollar.

Platform.

The objects of The American Institute of Quantity Surveyors and the purposes of its official organ, *The Quantity Surveyor* (published monthly), are as follows, viz.:

First—To promote by all legitimate means a better method of inviting Bids and of letting Contracts, such, for example, as is offered by the Quantity System of Estimating. This system necessitates the furnishing of perfectly clear drawings, complete specifications, and final interpretation of all doubtful questions before a Contract is let.

Second—To encourage simplification (by standardization or otherwise) of Specifications and Municipal Building Codes. The adoption of equitable forms of Contract. The establishment of "quality" standards to determine the quality of materials and workmanship.

Third—To favor the creation of Technical Tribunals in all large cities to insure just and immediate arbitration and speedy settlement of disputed questions arising between Owner and Contractor.

Finally—to consistently support all measures or things

*Architect, 354 Pine street, San Francisco, Cal.

which stand for square dealing between Owner, Architect, Contractor and Engineer, or which may promote the legitimate interests of either, or all of them.

Origin of Present Movement.

As author of this platform, during my European training as an Architect, I acquired a working knowledge of Quantity Surveying, and of the operation of the Quantity System of estimating. Arriving in San Francisco in February, 1891, it was a great surprise to observe the loose methods which prevailed in making up bids. At that period very few persons could be found who even knew the meaning of the word "quantities." In 1891, I gave an address in the Academy of Sciences Building, before the San Francisco Chapter of the American Institute of Architects upon the subject of "The Quantity System of Estimating." Some interest had been aroused among both Contractors and Architects, and I lost no opportunity of sustaining the interest by personal demonstrations of the many advantages attending the Quantity System of Estimating. This continued for several years. Another address on the "Quantity Estimating" problem was given before the "Technical Society of the Pacific Coast," and several articles were contributed to architectural and building journals. No opportunity of advocating the necessity for "Better Estimating Methods" was overlooked. By April, 1906, I had laid out a Quantity System of Estimating (after conferring with many Contractors) adapted to American requirements, and my plans were laid and ready for organizing an American Society of Quantity Surveying, the aim of which was "Better Estimating Methods" and higher ideals for all interested in inviting, submitting and receiving figures. Then came the destruction of San Francisco in April, 1906, and the loss of most things burnable. Increased responsibilities during the rebuilding of the city, alone interrupted my work in aid of the Quantity System.

It is intended that the policy of this organization shall be broad enough to cordially welcome anyone interested in its activities and conservative policy, which are believed to be **fundamentally** accurate, eminently practical, thoroughly adapted to American requirements, and in full accord with the spirit of the time.

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

THE VALUATION OF RAILROADS

DISCUSSION SUBMITTED BY C. D. PURDON,
MEMBER OF THE ENGINEERS' CLUB OF ST. LOUIS.

[Vol. 52, page 121, March, 1914.]

The following excerpt is taken from the brief of Chas. F. Mathewson in case of Kings County Lighting Co. v. Public Service Commission for the First District of New York:

"The proposition (to deduct "accrued depreciation" in valuing plants in rate-making) is so absurd on its face that it hardly needs discussion to show its fallacy. Why, aside from the question of 'confiscation,' should consumers, for exactly the same service, equally efficiently rendered, expect to pay less in the sixth year than in the first year, merely because some items of plant will (viewed at the sixth year) require replacement at a date in the future then nearer than such date was at the beginning of operation? As well, might it be claimed, to repeat a homely illustration, that a farmer should regulate the price of eggs which he sells, by the age of the hen which lays them—reducing the price of the product as the hen gets on in years. The reason he does not is that the service efficiency and operating value of the hen, as evidenced by the quality of the eggs which she lays, are not impaired by the fact that her life is advancing. That advancement may concern the farmer and possibly concerns the hen; but it in no manner affects the value of the eggs to the consumer, or justifies him in demanding them at a lower price than he paid at an earlier period of her life. The consumer of the eggs must expect to pay a sufficient price to afford a return to the farmer on his total investment in the hen during her life, plus enough more to enable the farmer on her death to replace her and thus keep his investment unimpaired. A farmer could hardly be expected to invest in hens for the purpose of supplying the public with eggs, if for a portion of their life he was to receive a return on only a third or a half of this investment; and any such rule would simply compel the public to go without eggs until the regulating power (if such there were) saw fit to revise its reasoning. There is absolutely no difference in the economic principles applicable to the operation of a gas plant and the operation of a hennery, so far as concerns right to return on

capital; and what is absurd in one case is equally absurd in the other. The fact that the rate of return in the one case is subject to reasonable regulation, and not in the other case, has no bearing on the main proposition."

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

OBITUARY

FRITZ AUGUSTUS HEINZE

MEMBER OF THE MONTANA SOCIETY OF ENGINEERS.

The Great Engineer of the universe, in His wisdom, called to His council one of our worthy members, Fritz Augustus Heinze, who, on the 4th day of November, 1914, obeyed the summons.

In his demise, The Montana Society of Engineers loses from their midst one of the most picturesque characters of the fast-changing West. Born of humble parents in Brooklyn, New York, on December 5th, 1869, he early showed an aptitude for engineering pursuits. This was encouraged by his parents, who afforded him the opportunity of perfecting himself in his chosen profession by sending him to Columbia University and School of Mines, supplementing this training by post-graduate work in celebrated European universities.

Thus equipped, he came to Butte when scarcely twenty-one years old, and entered the employ of the Boston & Montana Consolidated Copper & Silver Mining Company as mining engineer. In a very short time he realized the great undeveloped possibilities of the Butte District. The routine work of his department soon became chafing to his active mind. He severed his connection with the above company. With a prophetic vision as to the mining opportunities in Butte, he obtained financial backing, and entered actively into a campaign of acquiring desirable properties.

His star was in the ascendancy, and within a short time several successful mining companies were launched by him. This necessitated a reduction works for the treatment of his ores. Heinze, ever resourceful, burnished his Aladin lamp, and lo! a smelter was pouring forth slag and copper.

A man of wide range of associations and diversified business interests, of heroic mould, he became the idol of the multitude. His every wish was a law thereunto. A period of great activity before the public, and incessant demands on his time followed for several years. These demands were freely complied with, and his circle of friends greatly enlarged.

Fritz Augustus Heinze always cherished the laudable ambition of entering the larger and more national field of activities possible only in large centers of trade and business.

Accordingly, in 1906, upon disposing of his mining interests in Butte, he left for New York.

From this time on, he became interested in diversified industries, and the close attention and intense application no doubt proved too great a burden for his willing shoulders. He peaceably obeyed the summons we all in turn shall hear, leaving behind a large circle of mourning friends.

Respectively submitted,

FRANK M. SMITH,

A. E. HOBART,

D. C. BARD,

Committee.

Editors reprinting articles from this JOURNAL are requested to credit the author, the JOURNAL OF THE ASSOCIATION, and the Society before which such articles were read.

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NOTES ON NATIONAL FORESTRY IN MONTANA*

By FRANK R. INGALSBEE,†

MEMBER OF THE MONTANA SOCIETY OF ENGINEERS.

[Read before the Society at its Twenty-eighth Annual Meeting held at Butte, Montana, April 10, 1915.]

Conservation, as it affects our public lands, "deals with the earth itself and the use of the earth for the greatest good to the greatest number for the longest time."[†] I think very few, if any of us, will question the correctness of this statement as a governmental policy, or would vote against it from a moral or ethical standpoint. There may be some question as to what is meant by the "greatest number." I believe it was the intention of the originators that in this, as in other great governmental policies, we should know no state boundaries, but at the same time there are many of us who believe some phases of this policy belong to the state rather than to the federal government. However, I do not wish to bring into this discussion the "twilight zone" so-called, between the state's right and that of the central government, any farther than to acknowledge that such exists. We must bear in mind that our government is yet young and our national conservation policy is less than ten years old—altogether too young—and we must look to the accumulated experience of time

*Written by permission of the District Forester, Missoula, Montana.

†U. S. Department of Agriculture, Bureau of Forestry.

‡From "The National Movement for Conservation," by Gifford Pinchot, 1914.

and the guidance of wise statesmen to carry us through the initial period. In other words, while probably all of us agree with the idea of conservation, yet many of us in the West do not thoroughly agree with all phases of its operation as practiced at present. I believe that such differences will be remedied in time and that we can safely look forward with equanimity to the final solution. The public land states of the West have not yet completed the pioneer stage of their existence, and while that stage lasts it seems probable that the Federal Government will take considerable interest in their welfare. The conservation idea grew out of the forest policy which impressed upon the people of the United States the fundamental idea of conservation of the national resources.

In the latter half of the nineteenth century the spirit of the public land laws was settlement and development. With a public domain of one and a third billion acres acquired in the preceding half century—1803-1853—by purchase, discovery, exploration and cession, and with another third of a billion acres in Alaska constituting a later purchase, the Nation felt that it could be lavish with its lands. The wildness called for pioneers of every type, and large premiums were held out to capital, enterprise and individual initiative. Development was desired whatever the cost in lands that were intrinsically of little value without settlement. The same century that saw the creation of this national domain—an empire in itself—also witnessed the distribution of more than one-half of its acreage. Naturally this shrinkage has been coincident with national development in all lines of industry.

With advancing years the wise nation, like the prudent man, learns to husband its resources. Land values are now recognized, the purpose in both legislation and administration has changed, and highest development alone is sought. With the most and the best of the Nation's land already alienated, the national duty is to put to its best use that which remains.* Land classification, involving a first-hand acquaintance with the tracts under consideration, is the outcome of such a policy. The segregation of the public coal lands, phosphate lands, oil lands, water power sites, and the national forests, is the direct outcome of this classification.

*Bull. U. S. G. S. 537, p. 7.

The Forest Service

The Forest Service, with headquarters at Washington, D. C., is under the direct administration of a Forester, who in turn is under the Secretary of Agriculture. For the sake of administrative convenience, the country is divided into seven districts, each in charge of a District Forester, who has for assistants men who are specialists along their particular lines of work. In turn the district is divided into convenient sections of approximately one million acres in extent, known as National Forests, which are under the charge of Supervisors. The forest also is divided into sub-units of 100,000 to 200,000 acres under the supervision of a Forest Ranger. Forest Supervisors are responsible to the District Forester, and it is in the district office that matters of policy as relating solely to the district and local administrative problems are threshed out. As a matter of economy a large part of the technical work is also done from this office.

The District Forester has three or more Assistant District Foresters under him to take charge of special lines of work. The office of *Silviculture* under one of these men has charge of the inventory of timber supply, its perpetuation (or regeneration), the sale of mature timber, investigations looking to the more economic utilization of forest products and reforestation of denuded areas. Each of these lines by itself involves considerable investigation and expense, but each is essential as a link in the chain. The office of *Operation* is the center of the administrative activity of the district in all matters pertaining to the protection and improvement projects such as roads, trails, telephone lines, and the money allotment for their construction. The office of *Geography* is a branch of Operation; here all the important drafting work, such as the compilation of forest maps, bridge designs, blue printing, etc., is done, and the final survey of forest homesteads, free of charge to the settler, is made.

On the District Forester also devolve other duties, not strictly forestry problems, but which are incidental to national forest management in its present stage of development. Among these is the work of the office of *Lands* which deals with all questions involving the use and occupancy of land within the forests except those relating to grazing and timber lands. It is here, too, policies for the efficient handling and

higher development of national forest areas are formulated. Permits for ditches, canals, reservoirs, corrals, stock tanks, drift fences, telephone, telegraph and transmission lines, and logging railroads for the removal of timber, are obtained. Permits for hotels, stores, summer resorts and other similar uses of national forest areas, are under the supervision of Lands, in fact every use of a temporary character of land is regulated in this office. The leasing of water power sites and applications for listing of homesteads, land classification, and examination of mineral claims for patent is handled in the office of lands, in conjunction with other bureaus or departments of the Government at Washington. Questions involving the transfer of title to lands from the Government to private persons, such as homesteads and mining claims, are considered here in co-operation with the General Land Office; this also applies to easements for many purposes, grants to railroads and states, etc., but the *determination of questions involving title to unperfected claims in National Forests is within the jurisdiction of the Secretary of the Interior.*

Forest officers examine and report upon claims:

- (1) Upon request from the Commissioner of the General Land Office, or the Chief of Field Division;
- (2) Upon receipt from the local land office of notice of application for patent on a mining claim, or of notice of intention to submit final proof on an agricultural claim;
- (3) When claimants are making unlawful use of claims, or are holding them for unlawful purposes, or bad faith in connection with them is manifest, or when trespass occurs upon or under color of a claim.

While there are a few cases under class (3) coming up each year, they are greatly in the minority, and are hardly worth mentioning except that one such case causes more trouble and expense than many cases of the valid claim type.

The District Office also has an expert in *grazing*, whose duty it is (1) to protect and conserve the use of all national forest land adapted to grazing; (2) to look out for the perma-

nent good of the live stock industry through proper care and improvement of the grazing lands; and (3) the protection of the settler and homesteader against unfair competition in the use of the range. The Secretary of Agriculture has authority to permit, regulate, or prohibit grazing in the national forests. Under his direction the service allows the use of the forage crop as fully as the proper care and protection of the forests and the water supply permit.

The cattle and sheep grazed in the forests bear an important relation to the supply of beef and mutton in the country, particularly in the western states, and every effort is made by the service officers to promote the fullest possible use of the grazing resources. Furthermore, the utilization of grasses and plants diminishes the fire danger and helps protect the forests. Every effort is made to distribute the stock satisfactorily on the range, with a view of securing harmony among the users of the forest, reducing the waste of forage by trampling and unnecessary movement of the stock, and obtaining a more permanent, advantageous, and profitable use of the range. Excluding Texas and Oklahoma, approximately 4 per cent of the horses, 16 per cent of the cattle and 27 per cent of the sheep in the western states are provided with range in the national forests. The potential value of this animal forage crop may be illustrated by the animal products turned out each year from stock raised under permits on the forests of Montana. The approximate annual product of the sheep is 8 pounds of wool per head, and a natural increase equal to 85 per cent of the stock. The annual product of the cattle and horses is approximately equal in numbers to 30 per cent of the permitted stock. During 1914, permits were issued for 800,000 sheep, 140,000 horses and cattle, while in addition a large number of cattle and horses were grazed free. The estimated annual product of this stock was 6,400,000 pounds of wool valued at \$1,088,000; 680,000 lambs worth \$2,380,000, and 42,000 head of cattle and horses worth \$1,260,000—or a grand total of about \$4,628,000. (Forest forage produces actually about \$3,912,000 of this total.) The majority of the users are small owners who prefer the right to graze a fixed number of small stock rather than the right to use a specified range with a maximum but no minimum limit. The policy of the service is such as to encourage settlement on and near the

forest by giving them preference in range allotments over users who come from a greater distance.

There are seventeen national forests wholly within Montana, and a part of the Sioux Forest, so there is a total net acreage of national forest land in the state of 16,272,230 acres. During the fiscal year ending June 30, 1914, this cost the government about 3.24 cents per acre to administer, and the receipts therefrom amounted to about 2.29 cents, or a net loss of about .95 cents per acre; in other words, the government invested in the Montana national forests the sum of .95 cents per acre—a large part of which was for protection and regeneration of the forests, and incidental administration.

National Forests to be Self-Supporting

Estimates have been made by good authorities that the forest service will be self-supporting in so-and-so many years, and those estimates are based on past experience; but, judging from developments of the last few months, it appears that nothing is more certain than the uncertainty of the future. The world seems to be entering a critical period of its history,—when international treaties and contracts become only “scraps of paper;” when “might is right,” and men are educated to carry on organized scientific wholesale murder; when factories are turned into powder magazines, and our ocean highways of commerce are strewn with death-dealing inventions. Indeed, half the so-called civilized world appears to be experiencing a reversion to a condition not unlike the “dark ages.” Even if the United States keeps her skirts clear of the turmoil, it is doubtful whether our period of prosperity will not for a time be seriously checked. However that may be, it appears to be the present policy of the government to put the national forests on a self-supporting basis as early as is consistent with good forest administration, and that object will undoubtedly be accomplished sooner or later. There are about 165 million acres* of land under the Forester’s care, and the transformation of this almost virgin wilderness in the most rugged and inaccessible sections of our country into developed forest properties, yielding a cut of timber equivalent to current growth, not only self-supporting but paying revenues commen-

*“National Forestry,” W. B. Greeley, 1914.

The Montana National Forests

National Forest.	Supervisor's Headquarters.	Name of Supervisor.	Net Area, Acres.	Net revenue for Fiscal Year ending June 30, 1914.	Cost to the Government for the same year.
Abasroka	Livingston	J. D. Warner.....	847,148	\$ 9,364.97	\$24,655.87
Beartooth	Billings	R. T. Ferguson.....	664,802	13,021.70	17,299.79
Beaverhead	Dillon	C. K. Wyman.....	1,343,898	17,134.50	20,102.23
Bitterroot	Missoula	W. W. White.....	1,046,508	8,409.83	35,070.52
Blackfeet	Kalispell	R. P. McLaughlin....	879,734	33,069.97	44,480.53
Cabinet	Thompson	C. W. Griffin.....	851,172	13,467.95	29,973.53
Custer	Miles City	G. E. Martin.....	446,245	9,461.14	12,267.59
Deerlodge	Anaconda	L. C. Stockdale.....	858,876	80,032.10	42,712.70
Flathead	Kalispell	Donald Bruce.....	1,818,182	21,047.84	53,252.55
Gallatin	Bozeman	R. E. Bodley.....	570,208	6,110.48	20,424.34
Helena	Helena	J. B. Seely.....	683,302	20,819.90	25,176.19
Jefferson	Great Falls	Scott Leavitt.....	1,047,292	13,594.56	25,258.01
Kootenai	Libby	G. A. Smith.....	1,349,815	40,848.01	62,738.97
Lewis & Clark	Missoula	T. C. Spaulding....	813,469	4,404.27	19,468.50
Lolo	Chouteau	Elers Koch.....	859,583	39,363.80	41,309.90
Madison	Sheridan	R. G. Willson.....	1,003,237	33,195.99	26,249.56
Missoula	Missoula	Rutledge Parker....	1,082,948	6,760.87	23,443.33
Sioux	Camp Crook, S. D.	A. C. Haines.....	105,811	(In Montana)*	
			16,272,230	\$370,107.88	\$523,884.11

*Total area of forest, 200,002 acres.

surate with their physical value, is an undertaking such as no private or corporate capital would care to undertake. Such work is the function of a progressive government. Ten years will witness notable changes in the development of the national forests. This period should see the fundamental problem of fire protection largely reduced, by a perfected organization of

Districts of the United States Forest Service

HENRY S. GRAVES, Forester,
Headquarters, Washington, D. C.

Districts.	Headquarters.
Number 1	Missoula, Montana.
Number 2	Denver, Colorado.
Number 3	Albuquerque, New Mexico.
Number 4	Ogden, Utah.
Number 5	San Francisco, California.
Number 6	Portland, Oregon.
Number 7	Washington, D. C.

men and equipment, to terms of everyday insurance. It should see the cut of timber brought up from a small fraction of the possible yield to an amount approximating the current reproduction of the forests; from less than one per cent of the annual cut of forest products in the United States to a fraction which, while still minor, will be an important factor in the timber supply of the country, and an invaluable instrument for the maintenance of healthy competition in the lumber trade.

Reforestation

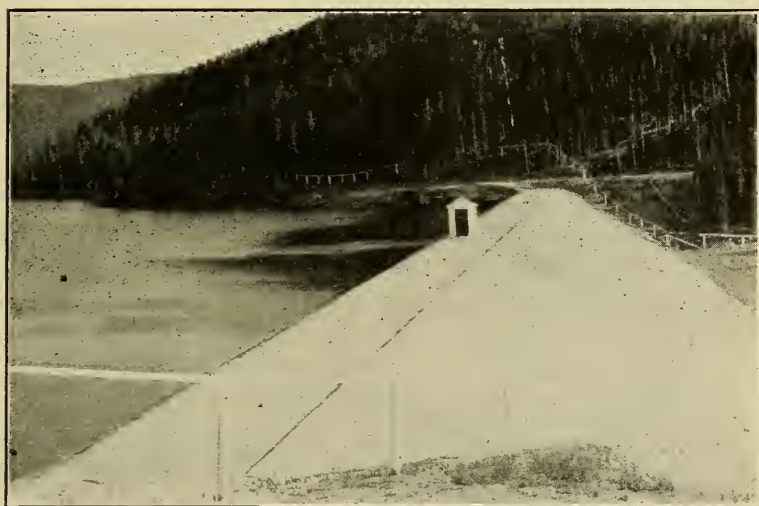
Another decade should witness a large increase, both in the physical value of the public forests and in their productivity.

This will be accomplished by the reforestation of many denuded areas, in part by the natural extension of tree growth, under protection from fire, and in part by planting areas that cannot be restored to their original forest condition without assistance.

While the work of the forest service is concerned primarily with practical features of administration, much remains to be done in the investigation of technical problems involved in efficient management. The problem of *closer and more profitable utilization of raw forest products*, and that of *artificial re-*

forestation, are perhaps the greatest immediate urgency. But other problems are also coming to the front.

Obviously it would be foolish to attempt refinement of scientific method in the present handling of these vast undeveloped areas, with their enormous surplus of over-mature timber. Year by year maps and estimates are pushed out over the regions where such data are most critically needed, but at a snail's pace comparatively, considering the enormous area that must ultimately be covered. Working plans will be attempted in the course of the next few years on a very few



Dam at Chessman Reservoir, Helena National Forest, Montana.

national forests, where the demand of local industries is making rapid inroads on the timber and there is danger of early depletion. In such cases, rough plans for regulating the cut will be worked out with a view to gradually restricting it to the current production of the forest.*

The great bulk of our pine forests lend themselves readily to partial cutting, conforming with the natural grouping of the timber by age and size, under which is retained a quarter or a third of the merchantable timber with usually a fair stocking of young growth, sufficient to afford a second cut in 30 to 50 years. In the heavy, even-aged stands of Douglas

*"National Forestry," W. B. Greeley, 1914, p. 6.

fir and western white pine in the Northwest, we have found the most practicable plan to be clean cutting, with the reservation of a small percentage of the stand for reseedling, to be supplemented in some cases by artificial planting. These simple provisions, with the cleaning-out of insects and disease as far as practicable and the burning of slashings, represent about all that should be attempted for the present in the way of technical forestry.*

From a practical standpoint, probably our greatest present concern on the investigative side is the effective utilization of the three or four billion feet of wood which by the end of the next decade will be cut annually from the national forests; and restoring to usefulness the five or six million acres of burned-off timber lands whose idleness represents an annual loss of at least half a million dollars. Technical investigation will be largely concentrated on these two problems.*

A chain of experiment stations has been established covering all the more important forest regions in the West, at which intensive studies of silvicultural methods on small areas are being conducted, together with observations on the influence of the forest on water storage and meteorological conditions. This chain of stations is in fact a series of miniature forests on which the problems of technical administration as they arise can be solved on a laboratory scale, and methods developed that can be applied with certainty on the forest areas surrounding them. Each station is manned with a corps of trained investigators who are seeking to develop the science of Western American silviculture.

Reforestation on the national forests in the past has consisted chiefly of experiments applicable to an enormous range of climate and soil conditions. Many serious difficulties and failures have been encountered in this preliminary work of developing a new science under untried conditions, often of an extremely adverse character.

"It has required a deal of bulldog tenacity and of steadfast refusal to admit defeat," says W. B. Greeley of the Forest Service, "to carry this work through to the point that has now practically been reached, of understanding the possibilities and limitations of this work in each locality. The reforestation

*"National Forestry," W. B. Greeley, 1914, p. 6, 7.

work of the service at Halsey, Nebraska, is, I hope and believe, indicative of this effort, of such direct and practical bearing on American forestry, in all the national forest regions. After many failures and partial successes in the Western Nebraska sand hills, methods have finally been developed under which plantations are successful practically every year, and by which we are now extending the work in that region at the rate of 800 or 1,000 acres annually. * * * On the national forests as a whole, the reforestation work has reached the point where it can now be extended on a much larger scale with reasonable certainty of the results. We have developed an equipment of 17 good-sized nurseries and 21 small nurseries, having an annual capacity all told of around 20 million seedlings. With this nursery stock and with a limited amount of direct seeding in a few localities such as the Black Hills, where this method has proved successful, the next 10 years should witness very definite progress in the reforesting our denuded lands at a rate of not less than 20,000 acres annually, increasing to that extent the permanent resources and value of the national forests."

The National Lumber Pile

"The increasing cut of national forest timber will make it more and more of a factor in supplying the national lumber pile. The chief significance of this fact is its bearing on the general economic situation as regards lumber supply and lumber prices. *We have on these public lands six hundred billion feet of timber, probably a fifth of the country's supply,*" says W. B. Greeley, "which the people own and which is to be used as the people direct. It might be thrown on the market rapidly at very low prices in an effort to reduce the cost of lumber to consumers."

"As far as such a policy succeeded, it would throw the lumber trade into a brief period of broken prices, liquidation of the weaker operators, and the most wasteful kind of exploitation. The margin of return on low-grade logs is always slight. In the periods of over-production and low prices, more and more of them will not repay the cost of manufacture and must be left in the woods. Not infrequently depressed market conditions have resulted in the waste of forty to fifty per cent of the material which under normal conditions is utilized."

United States Department of Agriculture, Forest Service
District No. 1—Montana Forests

Forest	Total Estimated Stand M. B. M.	Lodgepole Pine Percentage	Stand Per Acre Gross Estimate Divided by Net Area	Stand Per Acre Gross Merch. Estimate Divided by Productive Area	SPECIES In Order Of Commercial Importance		Range of Elevation	
							Low	High
Absaroka.....	1,365,000	60.	1.6 M.	4.7 M.	D. F.	Lp. P.	5400	11,300
Beartooth.....	494,158	41.	.74	1.6	Lp. P.	D. F.	4900	12,500
Beaverhead....	1,510,000	75.	1.1	2.	Lp. P.	D. F.	6000	11,000
Bitterroot.....	3,756,800	45.6	3.6	6.1	Y. P.	D. F.	3500	10,200
Blackfoot.....	2,254,000	10.	2.6	5.2	L.	D. F.	2700	7,400
Cabinet.....	3,425,000		4.	*8.5	W. P.	Y. P.	2400	8,000
Custer.....	300,500		.7	2.3	Y. P.	Ash	3000	4,000
Deerlodge.....	979,400	68.	1.2	1.9	Lp. P.	D. F.	5200	10,800
Flathead.....	6,300,000	13.	3.4	7.	W. L.	D. F.	3000	9,300
Gallatin.....	1,000,000	75.	1.7	3.2	Lp. P.	D. F.	5600	11,200
Helena.....	1,100,000	40.	1.6	1.9	D. F.	Lp. P.	3600	9,500
Jefferson.....	117,584	75.	.1	1.4	D. F.	Lp. P.	3800	9,000
Kootenai.....	12,000,000	.05	8.8	9.	Y. P.	L.	1800	8,000
Lewis & Clark.	2,500,000	30.	3.1	1.7	D. F.	Lp. P.	4500	9,000
Lolo.....	1,680,000	7.	1.9	2.5	L.	D. F.	2500	9,000
Madison.....	878,000	60.	.9	1.7	D. F.	Lp. P.	4800	11,200
Missoula.....	3,080,000	80.	2.8	4.1	Y. P.	Lp. P.	3300	10,600
Sioux.....	70,000		.3	.5	Y. P.	L.	3000	4,000

*Productive area low.

Latest Estimate Furnished by Office of Silviculture.

"In so far as extreme competitive selling of government timber would be able to force down lumber prices, therefore, it would throw the industry into a frenzied period of wasteful exploitation from which the country would emerge a few years hence with its public reserve gone, a large part of its private supply wasted, and the remainder in the hands of a few of the strongest survivors, exceedingly well placed to hold it at monopoly prices."*

"As a matter of fact, even the temporary boon of lower prices would not be secured by the public. As long as the great bulk of the timber supply is in private hands and the industry is so conducted on such a highly competitive footing as at the present time, no amount of government timber that it would be possible to throw on the market could affect prices materially. They are too well fixed by broad lines of competition from many producing regions; and the only result of sacrifice sales of public timber would be to increase disproportionately the returns of the fortunate operators who handled it. On the other hand the selling of national forest timber might be closely restricted, making these areas simply big reservoirs of wood held in cold storage until private supplies are exhausted. By keeping government timber off the market, this policy would, sooner or later as competitive conditions in the industry become less marked, enable the private operators both to utilize their timber more completely and to get higher prices for it. As far as there may be any tendency toward monopolistic control of the lumber industry or the extraction of monopolistic prices for its product, such a policy," says Mr. Greeley, "in the handling of government lands would strengthen and support it. Closer utilization of forest grown material in the course of time would undoubtedly be fostered, but at a corresponding, and not unlikely an unwarranted, increase in the prices paid by the consumer through the withdrawal of public competition."

"Advocates in plenty have urged on the Federal Government the adoption of each of these divergent policies. We conceive it to be our duty, however," says Mr. Greeley, "to do neither. We conceive it to be the first and foremost function of the timber retained in public ownership to maintain competitive conditions in the lumber industry whenever there

*"National Forestry," 1914, W. B. Greeley, p. 8.

shall be any tendency toward closely controlled production; and to prevent as far as is possible, through the sale of public stumpage, monopolistic increases in the price of forest products or increases unwarranted by rational adjustments of the trade to changed conditions of supply and demand. That is, as far as the public reserves can influence the market, it is their business to give the country the lumber it requires, at the lowest price justified by the supply available for present and future needs. The availability of large areas of public timber for purchase by an independent operator, who can thus at any time without timber holdings of his own enter the trade and compete with its vested interests, is the most effective check on monopoly that a country could possibly hold. Ultimately, when the lumber industry passes through its present highly competitive stage and the concentration of standing timber in a few hands which is now taking place tends towards monopoly in lumber production, the national forests will in just this way serve the interests of every consumer in the United States."

And at the same time the Service conceives it to be its duty to encourage effective utilization and discourage serious waste. It does not care to dispose of its timber below a certain point in competitive conditions—which point is determined solely by consideration of the public welfare requiring stable conditions in a manufacturing industry, rightly adjusted to its available supply of raw material—conditions that make for permanent operation on a reasonable margin of profit. You can readily understand that coupling this policy with close utilization of forest products is no easy task. It requires investigations on a large scale into the cost of putting the finished product on the market and experiments and practical tests along the lines of utilization of products ordinarily considered as waste. This requires a sound business policy based upon science and hard facts.

Forest Diseases

I have referred to forest diseases. It is surprising how epidemic and contagious diseases of trees are; they can almost be compared to diseases of the human body in number, variety and prevalence. Just now there is an epidemic killing the white pine in Western Montana and Northern Idaho.

Just how far this disease will spread, or how much timber it will kill before it dies out of itself or is checked, is a serious problem facing the forest doctors of the Missoula office. Investigation has shown that it is due to a beetle (*Dendroctonus monticolae*), with certain peculiar habits, which seeks out and kills only the white pine in the region referred to. During the summer season this beetle flies about from tree to tree, and when autumn comes it bores through the bark and lives in the inner bark in the form of larvae. During the winter it lays its eggs, and it is then that it gets in its fatal work. In the spring the beetle is again provided with wings, comes out, and spreads to the healthy trees. The young broods emerge from July to September. In the attempt to exterminate it, habits are taken advantage of something after this fashion: the infected trees are cut and the bark peeled off the logs while the beetle is nesting; it is exposed to the weather and dies before it has a chance to spread to other trees. This appears to be a drastic method, quite different from the process of isolation practiced among humans with certain diseases, but trees in a forest cannot be isolated as humans can, and curative methods adopted. Rather, stringent preventive methods seem necessary.

A common source of disease is the fungus, a plant which attaches itself to a wound on a tree and sends it root-like growths into the sap wood, gradually spreading, like a cancer in the human body, until the vitality of the tree can no longer resist its growth and finally succumbs. This form of infection is one of the commonest, attacking all kinds of trees everywhere. In fact the forests, especially mature forests, are full of it. There are a great variety of these fungi with a great diversity of habits, some favoring certain species or types of trees, while others seem confined to certain localities; other varieties are wide spread.

An interesting instance of an epidemic which died out in a short time, and which was confined to a limited strip of country, is known as the "Red Belt" injury of 1908-9. During the winter of 1908-9 in some portions of the Northwest, more especially in Montana, many forest trees suffered from a peculiar form of injury which was apparently due to weather conditions. This was most severe in the following national forests: Absaroka, Beartooth, Bitterroot, Blackfeet, Deer-

lodge, Gallatin, Madison and Jefferson. To quote from a paper* by G. G. Hedgcock of the Forest Service,—“During the past three years (that is, prior to 1912), in all about 40,000 acres of coniferous trees have died from its effects in Montana. This form of winter injury has received the name locally of the ‘Red Belt’ owing to the red appearance of the injured conifers, especially of the pines *en masse*, and the occurrence in most instances of the injured portion of the forest in narrow bands or strips of land, situated on the slopes of hills or mountains and running parallel to their bases, or to the valley floor below. The injury, judging from a consensus of observations by a number of observers, must have occurred in January, 1909, but was first noticed some time after it occurred, when the leaves began to redden and dry out. The injury to the conifers in the Deerlodge forest became a matter of controversy, and the question quite naturally arose as to whether any of the Red Belt type of winter injury had occurred in the Smelter Zone. * * * Smelter fumes and winter injury both redden the needles of pines in the more acute forms of each, but the smelter injury causes a brighter red color and does not so often kill the whole leaf as in case of winter injury. In case of lodgepole pine and of Douglas fir trees, the Red Belt winter injury in the acute form killed not only the leaves but often the terminal buds and twigs, and the whole trees died the season following the injury. * * *

“The Red Belt injury occurred while there was a deep snow in most of the forests affected, and the younger parts of small pines and firs were injured only above the snow, the older parts covered with snow remaining green and healthy. On the other hand young trees suffering from acute smelter injury die in a reverse order, the lower limbs, and the older leaves dying first, the upper limbs and younger leaves last, the snow affording no protection in summer.

“In the less acute form of Red Belt injury few terminal buds or twigs were hurt, and only the leaves were affected. The leaves were reddened where the tips were killed, and in many instances the trees were nearly defoliated by the death of the needles in 1909. New green leaves, however, were put forth from the terminal buds of the less severely in-

*Torreaga, Vol. 12, No. 2, Feb., 1912.

jured trees. Some of these were chlorotic in appearance. Slightly injured trees lost only a portion of the foliage and recovered their growth at once. * * * * * The forested area in which the trees were killed by Red Belt injury was small when compared to the total area of the forests affected. In Deerlodge National Forest, in the Smelter Zone, no greater percentage of the forest has suffered from Red Belt injury than has occurred in adjacent forests, in fact," according to the data collected by Mr. Hedgcock, "there is less of this injury.

"The ability of trees to withstand the Red Belt form of injury is not in the same ratio as that of their resistance to smelter fumes. In order of the susceptibility to winter injury the species are as follows:"

1. Western yellow pine.
2. Douglas fir.
3. Lodgepole pine.
4. Limber pine.
5. Engelmann spruce.
6. Alpine fir.
7. Juniper.

The Red Belt injury has sometimes been confused with damage from smelter fumes, but its nature is entirely different. Trees killed by the former die quickly as compared with those killed by the fumes. Weather-damaged trees which have recovered show a quick resumption of normal growth rate and a generally healthy appearance,—marked contrast to the trees suffering from the smoke fumes.

D. T. Mason, of the Forest Service, gives the following explanation of the cause of this injury.* According to this authority large areas were affected in the Black Hills and throughout the Rocky Mountains from Montana to Colorado. The belt was generally from 200 to 400 feet in width between elevations of 6,500 and 7,000 feet in the lodgepole region, and at lower elevations in the northwestern portion of Montana. Trees on all aspects were affected, but the greatest damage was done on southerly slopes and in situations exposed to the wind. The injury resulted from unusual weather conditions during the winter. In 1909 it was caused by a chinook

*Bull. U. S. Dept. Agric, No. 154, 1915, by D. T. Mason, p. 25.

of several days when the ground was frozen and covered with snow. The air was quite warm and the sun very hot, especially when reflected from the surface of the snow, causing the leaves of the trees to transpire all their available moisture. Since the roots were frozen and additional moisture could not be obtained from the ground, the leaves withered, and in some cases the buds dried out excessively. The most satisfactory explanation of the occurrence of the injury in altitudinal belt is that early in the winter, before the ground froze, snow fell at the higher elevations above the zone of injury. Later the ground in the belt froze solid, but not the ground below it. Later still the entire area was the only part of the region in which the ground was solidly frozen and no soil moisture was available to replace the water transpired by the leaves.

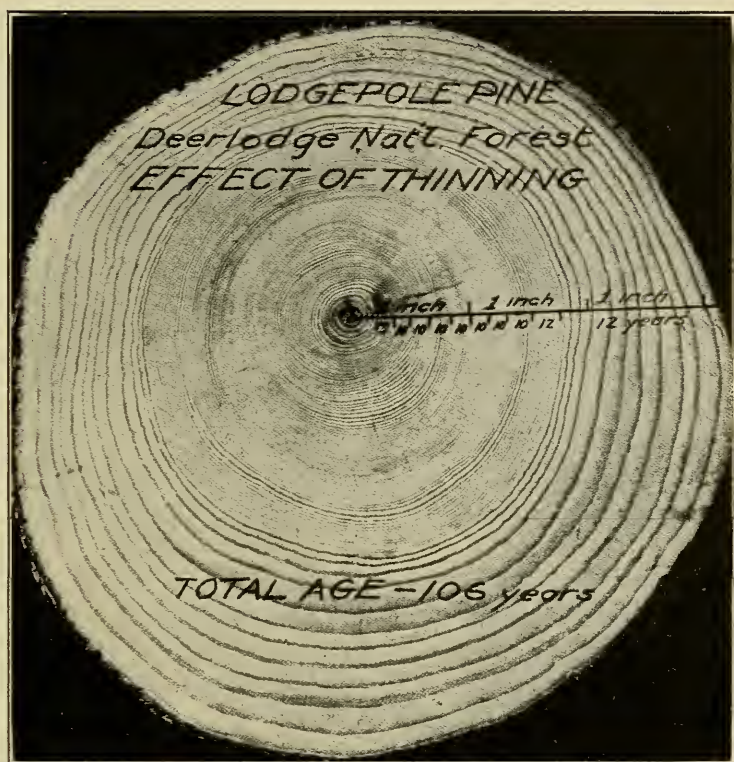
Lodgepole Pine.

The western part of Montana is in the heart of an immense belt of lodgepole pine extending from Colorado almost unbrokenly to the upper Yukon basin in Canada, corresponding very closely with the Rocky Mountain range. Another arm extends from Central California northward along the Cascades, joining the main belt in British Columbia. Its altitudinal range in the Rocky Mountains decreases from south to north; in Colorado and Southern Wyoming it is found at altitudes between 7,000 and 11,500 feet,—timber line. In Northern Wyoming at from 6,000 to 10,500 feet and in Southwestern and Central Montana at from 4,500 to 9,000 feet. As a rule, however, in Montana it forms commercial stands only within an altitudinal belt from 2,000 to 2,500 feet in width. In Montana the best stands are between 6,000 and 8,500 feet.* In the more humid northwestern portion of Montana, outside the main lodgepole region, the species grows at an altitude as low as 1,800 feet and occurs as a temporary type following fire with little regard to elevation. Lodgepole is one of the smallest of the commercially important pines. In well developed stands approximately 140 years old, at which age the tree may be considered mature, most of the merchantable trees are from 8 to 14 inches in diameter breast high, and from 60 to 80 feet high. The largest tree of record in the Rocky Mountains is on the Gunnison National Forest in Colorado, which

*Bull. No. 154, U. S. Dept. Agric., D. T. Mason, 1915, p. 1.

is 34 inches in diameter and 100 feet tall. There is one on the Deerlodge National Forest, Montana, 26 inches in diameter and 115 feet tall, containing six 16-foot logs scaling approximately 1,000 board feet.

Lodgepole seldom attains a very great age, because of fire and insect damage. Stands over 250 years old are uncommon. The oldest stand on record is on the Beaverhead National



Effect of Thinning Lodgepole.

After its release this tree increased in diameter from 3.5 to 6.3 inches in 12 years. In the last 12 years the tree has been growing at the rate of an inch in diameter in 4 years, while in the previous 12 years it had been growing at the rate of an inch in 25 years. The tree has been growing 772 per cent faster in volume in the last 12 years than in the preceding 12 years. Note the thin bark.

Forest, Montana, which has attained an age of about 450 years. Although the climate of the lodgepole is comparatively dry, it will probably grow only where there is an average annual precipitation of 18 inches or more. It is not total pre-

precipitation alone, however, but the amount of available moisture in the soil which determines the possibility of tree growth. This varies with the degree of slope, ground cover, and the permeability, kind, and depth of soil, and its degree of exposure to wind and sun. It is found on southern exposures at about 6,000 feet, provided the gradient is less than 10 per cent; but a steep south slope is generally too dry in Western Montana for the species. At the upper limit of its range lodgepole gives way to other and more tolerant trees. Increase in soil and atmospheric moisture encourage such species as Engelmann spruce and Alpine fir, while the relatively short growing season at high elevations does not furnish the total amount of heat which lodgepole needs for its growth. The range of the species is thus limited on the one hand by lack of moisture, and on the other hand by lack of heat.

Lodgepole is not exacting in its soil requirements, though it does best on deep, fresh, well-drained, agricultural land. The typical soil of the lodgepole region is gravelly with a considerable admixture of loam in valley bottoms and open benches, but with little or none on ridges and steep slopes. Unless lightened by a mixture of sand, gravel or loam, clays are usually not well enough drained, while limestone soils are apt to be too dry to enable the tree to make a normal growth.

In relation to light, lodgepole pine exhibits three striking characteristics—intolerance of any considerable degree of overhead shade, ability to survive for long periods in a badly crowded or suppressed condition in pure, even-aged stands, and in ability to recover and make increased growth after being released from suppression. It is this last characteristic which makes dense reproduction undesirable. The extremely dense stands which follow fire will remain dense indefinitely to the practically complete stagnation of growth. Some stands over 50 years old have more than 50,000 live trees per acre from 8 to 10 feet high. This behavior contrasts strongly with that of yellow pine, an area of which near Missoula, Montana, showed only 1,300 live trees per acre after 30 years in a stand which had originally numbered 3,500 trees per acre.*

*Cited previously, p. 7.

There is a general belief that lodgepole will not recover from suppression when openings are made in the stand. Recent investigations, however, prove that recovery does take place, and often to a remarkable degree. A certain tree studied was released from suppression 16 years ago, when 94 years old. Since then its diameter has increased from 1.44 inches to 5.06 inches and its height from 15 to 25 feet. The rate of growth has increased from 1 inch in diameter in 67 years to 1 inch in 4 years, and from 1 foot in height in 7 years to 1 foot in 1.6 years. After its neighbors were removed, the rate of diameter growth increased immediately. The rate of volume growth has increased 4,680 per cent.

Another interesting fact brought out by investigation is that most of the lodgepole stands now in existence have come in as a result of fire. On the other hand, areas formerly covered with lodgepole have been made barren by "double burns," where stands of young growth which followed the first fire have been destroyed by a second fire before they were old enough to produce seeds. Areas of this kind on which all the trees have been killed will not reforest naturally for many years, since the only way reproduction can take place is by seeding from the sides of the area.*

It would possibly be interesting to discuss some of the other important timber growths of this region, but the time is too limited.

Agricultural Land in the Forests.†

The first forest reserves were so designated under the provisions of the act of Congress of March 3, 1891 (26 Stat., 1095). This act merely provided for the reservation of land for timber purpose. The act of June 4, 1897 (30 Stat., 11), provided both for the production and supply of timber and the protection of watersheds, but expressly stated that it was not intended to include in such reservations lands chiefly valuable for their minerals or for agriculture. Since the passage of this last-named act, its provisions have continued to control the selection of lands for timber and watershed purposes, and no National Forest has been created without previous examination and classification of

*Previously cited, p. 14.

†From "Principles and Procedure Governing the Classification and Segregation of Agricultural and Forest Lands in the National Forests," Henry S. Graves, 1914.

the area which established the fact that the reservation, as a whole, was of the character authorized by law. It is recognized, however, that in setting aside any large area, such as a National Forest, there may be included some lands with cultivable soil which present opportunities for permanent homes and communities. As a matter of fact, such areas of agricultural lands are very limited in the National Forests, because the forests usually occupy high, rugged, cold mountain districts where agricultural possibilities are very restricted. In Montana forests, such lands are estimated as less than 2 per cent of the area of the forests. Yet, however limited in area and isolated as to locality, such patches of agricultural land should be allowed to pass into private ownership for development into farms, if large enough and productive enough to constitute practical farm units.

To meet the problem presented by these isolated tracts, the Forest Homestead Law was passed by Congress June 11, 1906. By July 1, 1912, about 12,000 homesteads, aggregating 1,144,359 acres, had been examined, listed as agricultural, and opened to homestead entry. For various reasons the act of June 11, 1906, did not work satisfactorily to either the homeseeker or the Service. Among other things, it placed the homeseeker in many instances at the mercy of professional land sharks. Representations were made to land seekers unfamiliar with the Forests, that vast areas of agricultural land would be examined and opened to entry upon application. These swindlers assured the would-be homesteader that in consideration of a fee, paid by him to the agent in advance, the latter would secure for the homeseeker the right to have 160 acres of land examined, which land, if found chiefly valuable for agriculture, would be opened to entry. Sometimes the agent made an effort to see that the land described in the application signed by his client was located where it might have some agricultural value, but just as often the land described was located on a rocky mountain side, impossible of cultivation or even permanent occupancy. This system defrauded the applicant of his money, and caused bitterness and disappointment on his part, which the operator in self-defense naturally deflected against the Forest Service by innuendoes of error, misrepresentations, prejudice, and fraud. To remedy this, Congress passed the act of August 10, 1912, which provided for classification and segregation of all the lands within the forests with possible agricultural value, and that is being

done according to certain principles based upon the law which places upon the Secretary of Agriculture the duty and responsibility of examining and of listing for settlement and homestead entry all lands in the National Forests which are found to be "chiefly valuable for agriculture, and which, in his opinion, may be occupied for agricultural purposes without injury to the forest reserves, and which are not needed for public purposes." By "agriculture" is understood the production of farm crops under established farm methods. Grazing is not contemplated in this definition, nor are values arbitrarily measured in dollars and cents according to the fluctuating market prices of the day, but are determined upon broad lines for the period of contemplated use. Clearly this classification should be a practical and sensible one. It should be as liberal as possible to both agriculture and silviculture. Certainly some land which raises good timber will also, with enough expenditure in clearing and preparation, raise agricultural crops; the result will be that our agricultural areas will contain some forest land and the forest areas some land having agricultural value. To attempt an absolute segregation into separate classes would be fatal to both agriculture and forestry.

The law prohibits the listing of land where such action would injure the Forests. If the listing will seriously interfere with or hamper the administration, protection, or use of the National Forest, then the listing is injurious. It is useless to administer a Forest if it cannot be protected and it is equally useless to administer and protect it if it cannot be used. Rights of way, roads, trails, telephone lines, lookout stations, ranger stations with pastures, logging roads, skidways, banking grounds, camp sites, etc., are absolutely essential to National Forest administration.

At the present time the right of way problem is one of the most irritating that we have to deal with; and this trouble of course comes from the homesteader and the mineral claim locator, largely the latter. The bona fide locator gives almost no trouble; it is the locator with ulterior motives, with purposes in mind not contemplated by the law, who makes serious trouble. Congress has been so liberal in making laws to encourage the development of mineral land, that it is a question whether the Government has left any effective legal means of adequately protecting its interests against unscrupulous locators.

Purposes of the National Forests.

Let me say in concluding that the National Forests exist for the purpose of insuring a continuous supply of timber and regulating the flow of streams. The lands, therefore, of which the Forests are composed, were selected from the public domain on account of their value and usefulness for such purposes, and Congress has made laws for administering them for those purposes. There is, I believe, a tendency on the part of the public to regard the Forests as it does unclassified public lands, which, of course, is a mistake, since the Forests have been set aside for specific purposes and the Service is doing what it can to carry out, in a broad, generous way, those intentions of our people as defined in acts of Congress.

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

FEATURES OF THE ELECTRICAL EQUIPMENT FOR THE GRANITE MOUNTAIN HOIST

By G. B. ROSENBLATT, E. E.

[Read before the Montana Society of Engineers at its Twenty-eighth Annual Meeting held at Butte, Montana, April 10, 1915.]

The hoist now in course of installation on the Granite Mountain Shaft of the North Butte Mining Co. is the first large electrically driven hoisting engine to be installed in Montana. It is, in fact, the largest on the two American Continents, and ranks with the very largest installations that have ever been made. On this installation particular attention has been given to economy of operation, reliability under all conditions, and "Safety First." Some data as to the duty to be performed and the electrical system decided upon, together with a brief description of the safeguards included, may prove of interest.

The electrical equipment on the hoist is designed to handle 7 tons of ore per trip. The ordinary operating rope speed is 2,700 feet per minute, but arrangements are made so that the speed can be increased up to 3,000 feet per minute. The equipment is designed to handle hoisting from various vertical depths down to 4,000 feet, and the cycles of operation have been chosen to give, approximately, capacities from various levels as follows:

300 tons per hour from the 2,000 ft. level.

250 tons per hour from the 3,000 ft. level.

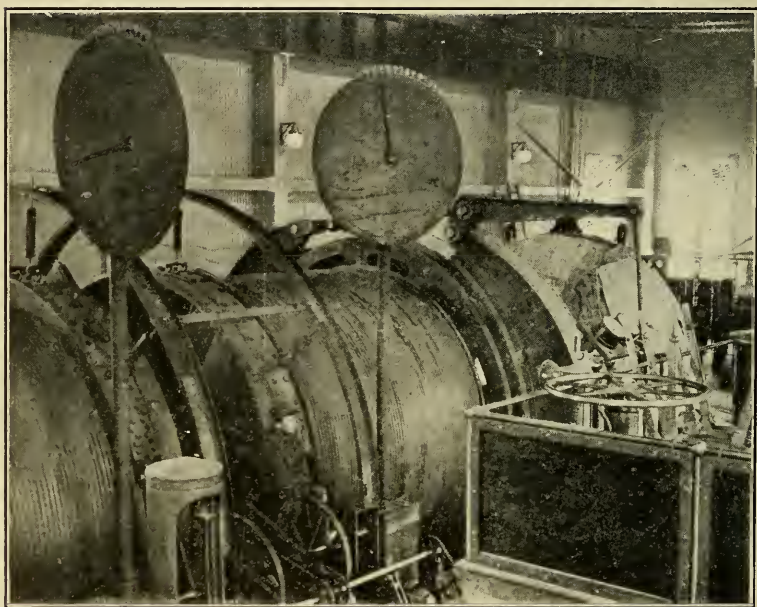
200 tons per hour from the 4,000 ft. level.

The hoist itself has cylindrical drums 12 ft. in diameter, and the rope to be used is 15/8-in. plow steel cable.

To drive this hoist with an electric motor and still not draw excessive peaks of power from the electric power line, a combination of apparatus known as the Ilgner System was decided upon. In this system a direct current motor is used on the hoist and supplied with power from a direct current generator forming part of a motor-generator set. The motor of this motor-generator set is supplied with power from the electric supply line. Mounted on the shaft of the motor-generator set is a fly-wheel whose duty it is to equalize the amount of power drawn by the alternating current motor from the power line.

To explain the system at some greater length, I would say that the power required to accelerate the hoist and its load from

standstill to the running speed of 2,700 ft. per minute depends of course on the rate of acceleration. In order to obtain the capacity desired from this hoist it was necessary to use a very high rate of acceleration. In fact, we figure on accelerating from standstill to full speed in about 15 seconds. This means that the power required to accelerate is very greatly in excess of the power required to do the hoisting once full speed is attained. The power required for hoisting averages about 1,500 hp., but



Hoist Drums and Part of Engineer's Platform.

to accelerate the equipment and the load requires peaks varying from 3,500 to 4,300 hp.

The flywheel on the motor-generator set supplies the extra energy (that is, the amount of energy above the average) required for acceleration, and the way it does it is as follows:

You all know that a flywheel gives up energy when it slows down, and absorbs energy when it speeds up. The motor of the motor-generator set, which drives the flywheel as well as the direct current generator, is a variable speed motor and has connected to it a controlling device known as a "slip regulator."

This slip regulator is so constructed that one element of it measures the power being taken by the alternating current motor of the motor generator set. It can be set to pass any given amount of power. On this particular installation we anticipate that it will be set to pass about 1,400 hp. If the hoist motor tries to take more than 1,400 hp. the slip generator immediately slows down the alternating current motor of the motor-generator set, which means that the flywheel delivers up some of the energy stored in it, and the hoist motor instead of getting any power in excess of 1,400 hp. from the electric supply line, gets it from the energy stored in the flywheel. When the hoist comes to rest, requiring no energy from the supply line, then the slip regulator speeds up the motor of the motor-generator which it can deliver the next time the hoist motor is accelerated. In this way the hoist may be operated at full capacity and still the draft of power from the power line can be controlled so as never to exceed a certain fixed amount.

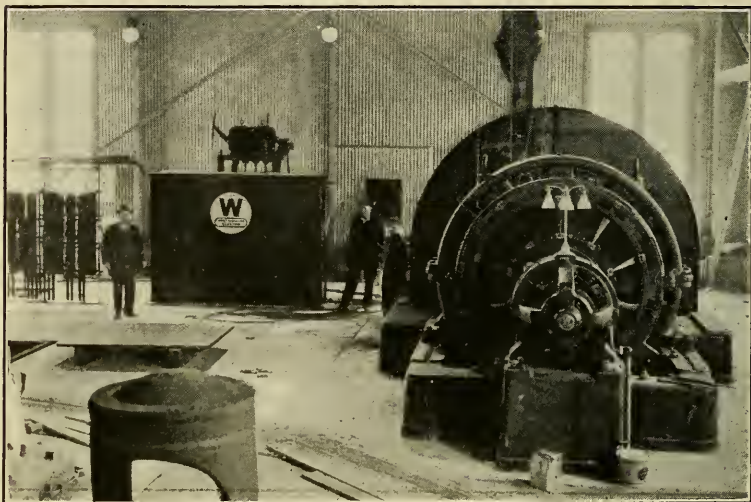
The sizes of the electrical equipment involved in this installation are as follows: The direct current hoist motor has a nominal continuous rating of 1,850 hp. Hoist motors not being operated continuously are usually given what is termed an intermittent rating, and this particular hoist motor has an intermittent rating of 2,750 hp. It is really big enough to pull 4,500 hp. for a short period of time and is guaranteed to do so.

The generator of the motor-generator set has a rating of 1,500 kw. and can deliver 3,750 kw. without trouble. The driving motor is 1,400 hp. The flywheel is 12 ft. in diameter, weighs 50 tons, and the whole set runs at speeds varying from 400 to 500 r.p.m., according to the action of the slip regulator.

The peripheral speed of the flywheel will be as high as 19,000 feet per minute. Naturally this causes some stress in the material of which the wheel is constructed. In order to prevent any possibility of a flaw in the wheel, it is assembled out of sheets of rolled steel plate, each sheet being $\frac{1}{2}$ inch in thickness and cut to fit the wheel. These various plates are being assembled together to a total thickness of $21\frac{1}{2}$ in. and then riveted. In designing the wheel the number of rivets used was such that the plates are held together with sufficient pressure to hold any one plate by friction alone, thereby eliminating any dependence on the shearing stress of the rivets. The steel used in the wheel has an ultimate tensile strength of 60,000 lbs. per square inch, which is many times

greater than the maximum stress possible in the wheel, so that in every way the flywheel is as safe as any flywheel can be made.

Naturally a flywheel of this size, presenting such a great area for air friction and running at such a high speed, will cause considerable windage. Windage is energy wasted in uselessly stirring up air, and, in order to reduce it and thus increase the economy of the set, the entire surface of the flywheel is very care-



Switchboard at left; Slip Regulator in center; Motor-generator set at right. Note fly-wheel is covered by steel housing.

fully finished. All rivets are counter-sunk flush with the surface. The entire wheel is carefully cut and finally polished and lacquered, so that it will present as smooth a surface to the air as possible, and thus reduce friction. Further the amount of air that could possibly be moved by contact with the wheel is reduced by totally enclosing the wheel in a sheet steel case carefully finished on the inside and fitting as closely as possible about the flywheel. It was considered at one time that it might be advantageous to run the flywheel in a vacuum, but investigation proved that while such operation was feasible, the application involved complications without sufficient increase in economy to compensate. Tests indicated that the friction and windage losses running the flywheel in the open air would be between 80 and 100 hp. By enclosing the wheel in a properly designed cover, these

losses could be reduced to something like 50 hp. Excluding the air from the cover did not seem to reduce the losses by more than 12 or 15 hp., which saving in power would hardly pay for the application of the necessary water-sealed glands, air pump, and changes in case construction to resist the external atmospheric pressure.

A flywheel of this size requires heavy bearings to support it. The bearings for the flywheel used on this set are 18 inches in diameter and 46 inches long. They are designed to be water-cooled, and are provided with gravity forced feed lubrication.

Now for some remarks about the safety devices included. The things to be guarded against in an electric hoist are:

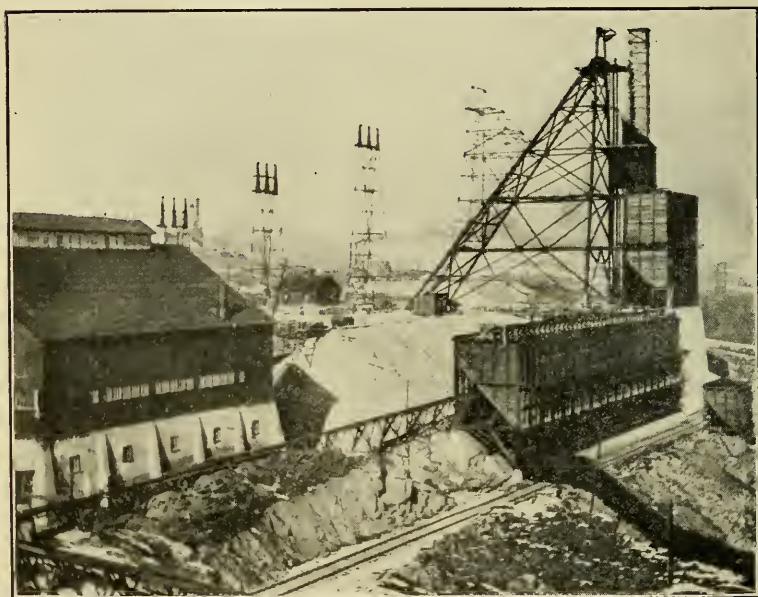
- (a) Careless operation.
- (b) Failure of power.
- (c) Unforeseen physical accidents.

(a) Under careless operation should be considered:

- Starting too suddenly.
- Overwinding.
- Failure to apply brakes.
- Overloading the equipment.
- Over speeding.

We believe we have protected this equipment against any of these contingencies by the system of control installed. Most moderate size direct current electric hoist motors are controlled by inserting resistance in series with the armature circuit. On this installation what is known as the Ward-Leonard system of control is used, and the speed of the hoist motor is controlled by varying the voltage supplied to the motor armature. The voltage is controlled by regulating the field of the direct current generator of the motor-generator set. This field is controlled in about 30 steps by magnet switches operated by contacts on a controller manually actuated from the hoist platform. Its operation is, however, not placed entirely within the control of the hoist operator. The magnets of the magnet switches are interconnected among themselves through relays so that the operation of each successive magnet switch is, as you might say, responsible for the operation of the next succeeding switch. Further, the hoist is provided with a Wessinger overwinding and safety stop device provided with electric limit switches, which are also connected with the magnet switches.

With this combination of control devices it is impossible for the operator to start the hoist too suddenly. The magnet switches are arranged so that they will not close at more than a predetermined speed. The closing of each individual switch is responsible for the operation of the next succeeding switch, and a current relay prevents them operating at any rate which would permit the hoist motor being speeded up too fast. The operator may throw the controller to a position corresponding to any speed he desires and the motor will come up to and attain that speed, but only at a predetermined rate of acceleration.



New Dry at left; Ore Bins, Head Frame, Idler Towers at right.

Overwinding is prevented by the operation of the Wessinger safety stop device which is so connected with the controller that when a cage passes a predetermined point a certain distance below the collar of the shaft, the controller automatically cuts resistance into the generator excitation circuit gradually reducing the voltage and consequently the speed of the hoist motor. If the operator in an emergency ever wanted to stop the hoist very promptly he could do so by deliberately plugging the motor, but the action would have to be deliberate, and could not readily

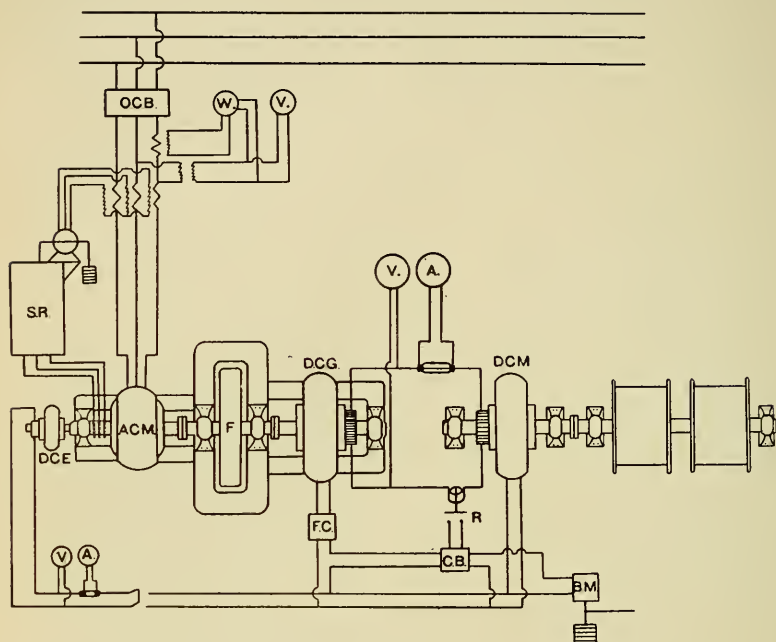
be accomplished inadvertently in the ordinary course of operation.

Failure to apply brakes is taken care of by equipping the system which operates the brakes with two electro magnets connected to emergency valves in the brake operating system. These magnets are so connected that in certain emergencies their magnetism fails causing the valves to apply the brakes.

Overload is guarded against in two ways. It is rather difficult to overload an equipment of this sort due to the fact that the capacity of the electric machines is ample to take care of any load that can be put in the skips, and the control devices effectively prevent the equipment being speeded up too fast. For this reason the circuit from the direct current generator to the hoist motor is solidly connected without any switch or circuit-breaker between the two machines. Accordingly, in case of overload there is nothing to disrupt the service. What will however happen is that the slip regulator and the flywheel will get into action in case of overload and prevent the hoist motor from being supplied with more power than is good for it. The operator could nevertheless overload the hoist motor by trying to push past some impassible obstruction in the shaft, and to prevent any such possibility an overload relay is connected in the circuit between the direct current generator and the hoist motor. This relay does not open the main circuit, but operates a circuit-breaker in the circuit controlling the field of the direct current generator. The circuit-breaker is built with two poles, and in case the overload relay trips it, one pole opens the generator field circuit thus cutting off the excitation, while the other pole opens the circuit to the brake magnets, thus applying the brakes the moment the field circuit is broken.

Protection against over-speed is given largely by the type of motor used to drive the hoist. This is a separately excited shunt wound machine. Unlike the ordinary series wound motor used for smaller hoisting work, the speed of a shunt wound motor is practically independent of the load. A series motor will speed up often to a dangerous degree, if the load is removed. A shunt wound motor will not do so. Its speed can only be increased by raising the voltage supplied to the armature or decreasing the excitation supplied to the field. The maximum voltage that can be supplied the armature on

this particular installation is fixed by the maximum voltage that can be supplied by the generator of the motor-generator set. There is no way of raising this voltage to a degree that will permit dangerous overspeed. The amount by which the separately excited field of the hoist motor may be weakened is also very definitely limited. This field is excited, not from



- O. C. B.—Oil circuit breaker with low voltage and overload trip.
 S. R. —Automatic liquid slip regulator.
 A. C. M.—Alternating current wound rotor induction motor.
 D. C. G.—Direct current separately excited generator.
 D. C. E.—Direct current shunt wound exciter.
 D. C. M.—Direct current separately excited hoist motor.
 B. M. —Brake magnet releasing hoist brake.
 C. B. —Circuit breaker for exciter circuit.
 R. —Relay for operating circuit breaker in generator field.
 F. C. —Field Controller. H.—Hoist. A.—Ammeter. V.—Voltmeter.
 W.—Wattmeter.

the main generator of the motor-generator set, but from a smaller exciter generator mounted on the end of the motor-generator shaft. Its voltage is maintained constant by a Tirrell regulator. With full voltage across the hoist motor field the excitation is such as to permit a rope speed of 2,700 feet per min. being attained with the hoist. For emergency opera-

tion it is possible to raise this rope speed to 3,000 ft. per min. by inserting a certain fixed resistance in the exciter circuit, and thus weakening the excitation of the hoist motor. This extra resistance can only be inserted in the hoist motor field by deliberate action on the part of the hoist operator. I say deliberate action because to insert this resistance and obtain speeds between 2,700 ft. per min. and 3,000 ft. per min. necessitates the deliberate release of a latch on the hoist control platform. The only condition that would permit obtaining a higher speed on the hoist motor would be a further weakening of the shunt field and this could only be obtained by failure of the excitation circuit. The brake magnets previously mentioned are connected in the exciter circuit and failure of the excitation would immediately set the brakes.

With the arrangement of electrical equipment selected, speed control is obtained on lowering in the same manner as it is obtained in hoisting, the motor in this case acting as a shunt wound generator and as long as the motor is clutched to the drums the hoist cannot attain overspeed.

An interesting additional device furnished in connection with the speed control is a knife switch which may be thrown into action when hoisting men, and when thrown limits the value of the voltage that can be applied to the hoist motor armature to such a value as will give a predetermined safe speed. This speed may be adjusted to suit local conditions. It simply fixes a rate of speed which cannot be exceeded as long as the knife switch is closed.

(b) Failure of power to the hoist motor may occur for two general reasons:

Either the power supply to the motor-generator set may be interrupted;

Or one of the connections between the various pieces of apparatus may be broken.

If the power supply to the motor-generator set fails, the fly-wheel will continue to drive the set for a considerable period of time. The hoist may be operated for one or two trips with reduced loads at moderate speeds by using the energy stored in the flywheel. Power is supplied to the motor-generator set through a circuit-breaker equipped with no-voltage release, and this breaker will open in case of failure of power from

the supply line. If power returns before the flywheel has lost very much speed all that is necessary is to reset the circuit-breaker. If, however, power remains off the line for a considerable period of time so that the speed of the motor-generator set has dropped below the predetermined point, the excitation will fail and render the hoist operating mechanism inoperative, at the same time releasing the brake magnets.

Protection against accidental failure due to the breaking of any of the electrical connections between the various pieces of apparatus is guarded against by making all of the control equipment operate by the application of power rather than depending for any operation upon the interruption of power. The brakes are locked by failure in any part of the excitation circuit. The main circuit from the direct current generator to the hoist is, as stated above, tied together solidly without switch or circuit-breaker. There is therefore nothing in this circuit to open, but should it for any reason be opened, it can be arranged to operate the circuit breaker in the brake magnets circuit, and thus apply the brakes.

It will be seen from the above that any operation of the hoist is therefore well guarded against any accident due to failure of power.

(c) The only other causes of possible accident are therefore unforeseen physical causes, such as the jamming of the cage in the shaft, fainting of the operator, or the like. It is impossible to guard against all possible accidents of this sort. The best we can do is guard against the results of such accidents as have in the past come within our experience, and such as are liable under extreme conditions to be met with on the present installation. If the cage does jam in the shaft it will immediately operate the overload relay in the main circuit which will trip the double pole circuit-breaker in the excitation circuit, bringing the motor to rest and setting the brakes. If the operator does faint while a trip is in progress the overspeed and safety stop devices will slow the hoist down as the cage approaches the collar of the shaft and will ultimately bring the motor to a standstill and hold the cage suspended at the collar of the shaft with just enough current flowing through the armature circuit to counterbalance the weight of the load. With the equipment that is being installed we would have no hesitancy in starting a cage or skip

from any level by simply throwing the lever into the full speed ahead position and calmly walking away. We know that the automatic devices will bring the hoist to rest when the skip or cage approaches the collar of the shaft. We would have no fear of the safety devices not operating because they are all of the type that operates every time the hoist operates, and therefore are always in operating condition. They are not emergency devices of that dangerous type which are called upon only to operate when things go wrong and are then found to be in an inoperative condition.

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

COST OF INITIAL MINING EXCAVATIONS

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[Read before the Montana Society of Engineers at its Twenty-eighth Annual Meeting held at Butte, Montana, April 10, 1915.]

A large part of the early development work on most mining properties consists of surface excavations, such as open cuts, trenches, shallow shafts, and short tunnels. Of this work the greater proportion may be classed as the annual labor performed on unpatented claims. This assessment work entails the expenditure of large sums each year throughout the mining regions of the West. The unit cost of this work, of course, varies greatly under the peculiar conditions applicable to particular localities. There is, however, a much greater difference in the cost of mining work in separated regions as depth is reached.

The writer, during the last four years in the Northwest, inspecting about \$500,000 worth of surface prospect work, has taken many opportunities to collect authentic cost data along this line. The figures given in this article are all for hand work. In the specific cases to which references are made, an average efficiency of the labor was obtained. With a higher efficiency, undoubtedly much lower costs could be shown in some cases.

The performance of assessment work is not taken seriously by a great many people, particularly when the owner does the work himself, not with a view to the real development of the ground, but merely to enable him to hold it. In such cases it is only natural to expect that the amount of work will be stinted. Men usually apportion to themselves higher wages than they could obtain elsewhere, and in addition work very short hours. Where owners hire the work done, no matter for what purpose the ground is held, they aim to get full value for the money expended.

There is a sort of tradition among many miners and claim owners that all assessment work is worth \$10 per foot, and that the government will allow that valuation for the work when passing on claims for patent. This is not the case,

*U. S. Dept. of Agriculture, Bureau of Forestry.

however, as the law pertaining to the statutory expenditure on a claim is very specific as to the value of the work required, and no mention is made of feet or yardage. When a full \$100 has not been expended as annual labor on an unpatented claim, it is subject to adverse location, no matter how many feet of work have been done. Accordingly, it behooves every owner of unpatented mining property to acquaint himself with the reasonable value of work performed upon his claims, so that he may be in a position to protect himself from a charge of abandonment for failure to do the requisite amount of assessment work.

Quite often among non-mining claim owners, or even among some mining men, there is a misconception of the actual cost of surface mining work. A miner, on completing work on a mining claim, will generally report so many feet of tunnel run, or of shaft sunk, for a certain amount of money expended. To a man who has no way of knowing the cost of surface work, this reported cost may sound reasonable, but not to a man of experience in this line. As an instance: a miner, who had been hired by a claim owner to do the annual labor, reported a 10 ft. shaft sunk for the \$100. The owner, who remembered reading mining companies' reports of shafts which cost from \$40 to \$150 per foot, considered he was receiving his money's worth; while, as a matter of fact, the miner should in this case have sunk four 10 ft. shafts for the \$100.

Throughout the country great numbers of unpatented mining claims which show promise, and in which the owners have faith, are held by business and professional men who, in having the annual assessment work performed, want every dollar to count in the way of developing the ground. Usually men are employed on a daily wage basis to do this work, nearly always unsupervised. It is difficult to get full returns for the money thus paid for unsupervised labor, but a great many claim owners insist on getting fair returns and take steps to insure good results by making it clear to the miners that they are not going on a picnic, and checking up the work as often as possible.

There is no doubt but that, ordinarily, greater efficiency can be obtained from men working under direct supervision,

as in a city trench, than working without it in some remote place. This does not, however necessarily mean that the unit of a large operation carried on by fully supervised labor can be conducted more cheaply than can the small job performed by unsupervised workmen. This is attributable to the absence of all overhead and depreciation charges on small jobs, such as large contractors have to carry. Quite often where only a few men are working there is no overhead expense whatever to charge against the cost of the work.

Another thing to keep in mind is the correct number of men to be put on a job to get the best results. In this respect there are other things to consider besides the placing of the men with a view of working to the best advantage. A case has been directed to the writer's attention where two men were sent out to a camp in the hills to do the annual labor on two lode claims. After the completion of the work on the first claim, a third man was sent out to help finish the job. In checking up the results, it was found that more work was done for the \$100 on the first claim than on the second, under identical working conditions. The mystery was finally solved when it occurred to the owner that "slough" is a three-handed and not a two-handed card game.

Increased cost of work naturally results where higher wages are paid and the working day is shorter, but the resulting increase is seldom as much as the price per hour per man would appear to indicate. Men working on an 8-hour day will generally do a greater amount of work per hour than those working on a 10-hour day. It was noted in places underground that when an 8-hour, instead of a 10-hour, schedule was put into effect, practically the same amount of work was accomplished in the shorter shift.

Better work may be expected, other conditions being equal, from miners in a \$4 camp than from those in a \$3 one. The mines paying the higher wages naturally have a larger number of men from which to choose their workers. As a rule, high priced men are more efficient than those receiving smaller wages. As an example: on a rush job miners at \$3.25 per 8-hour day were put to work to help finish an excavation on which a Greek section crew were working at \$1.75 per 10-hour day. The cost per cubic yard of the work done by the miners was a little less than that done by the section crew. This is,

of course, an exceptional case, and allowance must be made for cost per hour of labor.

Places where surface excavations are made are generally in the outskirts of the main districts, or in places remote from centers of population, where it is necessary for the men either to go some distance to work or live at a camp. Generally, the more efficient men are not obtainable to do this work at the standard scale of wages for the locality. Usually, such jobs are relatively short, and have other obvious advantages, to offset which it is often necessary to pay 25 or 50 cents per shift more than the standard scale.

It sometimes occurs, though seldom, that a shaft or tunnel may be started at the surface where the rock is unaltered and may be as difficult to excavate as at depth. Ordinarily, the work in rock is affected by weathering and decomposition. In most mining districts, the sedimentary rocks are shattered and softer at the surface and beneath for an appreciable depth. The igneous rocks also have the same tendency toward disintegration, particularly in the vicinity of veins. Exposed rock is very seldom as hard as that found at depth.

The simplest forms of development work are open cuts and trenches. Later, when the location of the lead is determined, shafts may be sunk, or, if the contour of the ground is favorable, tunnels run.

In computing costs, open cuts and trenches are calculated on a cubic yardage basis, and shafts and tunnels by the linear foot, due allowance being made for the size of the cross sections. A good method of arriving at the cost of vertical surface excavations is to figure the first 7 feet as an open cut on a yardage basis, and from there down as a shaft at so much per foot in depth. Material can be readily thrown with a shovel from a depth of 7 feet. To do so from a greater depth increases the cost per cubic yard, and, where a windlass is to be installed in any event, it is not economy. It is common practice in city trenches, and to some extent in shafts where no greater depth is desired, to throw material from a distance of 8 or 9 feet below the surface. Shafts are often sunk to a depth of 15 feet or more without installing a windlass, the material excavated being thrown to the surface by means of benches. The broken rock is thrown from the bottom to a bench, and from there to the surface.

The cost per cubic yard of open cuts varies from 50 cents to several dollars; prospect tunnels from \$2.50 to \$30 per foot; and prospect shafts from \$4 to \$40 per foot, depending upon the varying conditions. The cross sections of such tunnels and shafts are generally 4x6 feet.

At Butte, with miners' wages \$3.50 per 8-hour shift, the cost of open cut work averages about \$1.00 per cubic yard. The formation is a quartz monzonite, locally known as the Butte granite. This rock, with the exception of unaltered boulders and an occasional ledge of solid granite which outcrops, decomposes at the surface and to quite a depth in the proximity of veins. The boulders are mainly at the surface, but are frequently found below and in veins at depth. There is nearly an entire absence of any angular slide over-burden. At points where the granite is well disintegrated, the cost of open cut work will be less than \$1.00 per cubic yard. On the other hand, where boulders are encountered and in ledges of solid granite, the cost will be considerably higher. Excavations in this district are nearly always started in the decomposed granite. There is not much object in starting them in hard rock, as no vein outcrops are found in the unaltered portions. The altered granite near the surface is mostly picking ground, and little blasting is required in open work.

The cost of short tunnels from the surface at Butte runs from \$3.00 to \$8.00 per foot, except some work on the main range in hard aplite which costs over \$10.00 per foot. In the majority of cases involving decomposed granite, the cost is between \$4.00 and \$5.00 per foot. This includes cutting the timber, if standing on the claim or nearby, and placing it in the tunnel, but not its purchase price or the expense of bringing it from a distance. Generally, where the rock is soft enough to require timbering, the greater ease with which it is broken will compensate for the extra labor of cutting timber and putting in sets. Where the tunnels run into spiling ground and into hard boulders, the cost will, of course, be increased. These figures, of course, do not refer to tunnels of large cross section in the solid granite in the deep mines.

The cost per foot of sinking prospect shafts in the Butte granite depends on the amount of decomposition of the rock, and on the depth of the shaft. Prospect shafts are generally about 4 ft. wide and 6 ft. long, as this makes a convenient

sized excavation in which one man may work. The average cost of a 4x6 shaft 15 ft. deep is about \$5.00 per foot below a depth of 7 feet, the upper 7 feet being figured on a yardage basis. The cost increases with depth. A 4x6 shaft 10 ft. deep is generally considered by some of the United States Mineral surveyors and others at Butte as costing \$25. This is generally a fair valuation, but in some cases it is a little high.

Patent work amounting to \$25,000 done under the supervision of two men on about fifty scattered lode claims, ranging from four to six miles from Butte, showed a cost of 80 cents to \$1.25 per cubic yard for open cut work, and an average of \$5.00 per foot for tunnels. The work done on a single claim of this number for an expenditure of \$500 aggregated 113 cubic yards of open cuts and a partly timbered tunnel 3x6x84 ft. long. The cost of the tunnel, by allowing \$1.00 per cubic yard for the open work, was \$4.60 per linear foot. The work on all of the claims consisted of open cuts and tunnels, with a few shafts. The deepest shaft was 55 ft. deep, and the others were comparatively shallow. The cost of the deepest shaft to a depth of 47 ft. was \$370, or nearly \$8.00 per foot, and to the depth of 55 ft. \$470, making the last 8 feet cost \$12.50 per foot. This shaft was sunk on a vein on a 45° incline, and was cribbed with an inside measurement of 3x5 feet. The broken rock was hoisted by a hand windlass in a bucket sliding up on guides. In this case, the construction of the windlass and frame and other extra work made up for the smaller cost of the first 7 feet. The formation was more or less decomposed Butte granite, and required blasting. From the last part of the shaft some water had to be bailed. Fifty-five feet is just about the limit for economical sinking with a hand windlass.

Another shaft 4x6, 15 ft. deep, cost \$48. This amounted to \$1.00 per cubic yard for the first 7 feet, and a little over \$5.00 per foot for the remainder.

According to Mr. Flood, during the last few years the cost to the city of Butte of excavating the material in sewer trenches within the granite area amounted to \$2.16 per cubic yard. The trenches were 2 feet wide and averaged 9 feet deep. All the work was done by contractors. Wages for ditch diggers are \$4.00 per 8 hours, this being the minimum price for all laborers on city work, and is 50 cents per day

more than is now paid to miners. This rate of wage has been fixed by ordinance of the city government. City contractors in Butte have to contend with numerous labor union regulations. The higher cost per yard of this work than for open cut mining is due to the labor situation, the great depth and small width of the trenches, and the larger proportion of solid granite, consisting of boulders and ledges included in the softer material which has to be moved.

A 300 ft. tunnel run from the surface in a hard, compact granite cliff at the head of Rattlesnake Creek in Beaverhead County, Montana, cost \$28.00 per foot.

Several hundred feet of prospect tunnels on the Porphyry Dyke in the Remini District, Montana, were run by contract for \$3.00 per foot.

Prospect tunnels in the soft porphyry in the lowlands district, Montana, cost from \$2.00 to \$5.00 per foot.

Tunnels in the soft schist in the Crevasse Mining district, Montana, cost from \$4.00 to \$5.00 per foot.

In the Coeur d'Alene mining district there are very few outcrops, and the surface on the mountain sides is generally covered with soil and angular wash to a depth of 2 to 8 or 10 feet. Under the overburden, the formation in place usually is broken and shattered to an appreciable depth, but very seldom over 15 feet or 20 feet. The formation is a series of sedimentary rocks which are, on the whole, easily eroded and weathered. There are a few hard strata, such as the copper beds in the Revette quartzite, which resist weathering, and are as hard at the surface as at depth, but these comprise only a very small part of the whole series. Miners' wages are \$3.50 for 8 hours. The cost of surface cuts here is found to be a little higher than at Butte, averaging about \$1.20 per cubic yard for the material removed. Individual cuts cost from 75 cents per cubic yard when in wash, to \$2.00 per cubic yard when in the harder rock. The average cost of a series of cuts up to 7 feet in depth on flat surfaces and with 12 foot faces on side hills, was \$1.20 per cubic yard. In classifying the material, most of the rock in place in open cut work would come under the head of loose rock. The average rock in the Coeur d'Alene is much softer than the solid granite at Butte, but harder than the altered granite.

The cost of prospect tunnels in the Coeur d'Alene ranges

from \$3.50 to \$10.00 per foot, according to the hardness of the rock, with an average of about \$6.00. The contract price of a tunnel in the shale above Pottsville, Idaho, from 400 to 500 feet from the portal, was \$4.50 per foot. The total cost to the contractor, however, was \$3.50 per foot. Surface prospect tunnels run by one of the mining companies in hard quartzite at Burke, Idaho, cost \$10.00 per foot.

Annual assessment work on five placer claims twelve miles from the railroad on Pend Oreille river, in Washington, showed an average cost of \$3.23 per cubic yard of rock removed. Wages, \$3.50 for 9 hours. The formation was tough, compact limestone and dolomite, with an entire absence of all surface weathering and overburden. The cuts were made in the bluffs above the river.

Development work in open cuts on lime placer claims at Metaline Falls, Washington, in solid limestone, cost from \$2.50 to \$4.10 per cubic yard.

The cost per cubic yard of open cuts on a vein in disintegrated andesite on the north half of the Colville Indian reservation, Washington, was 94 cents per cubic yard. The cuts averaged 34 feet long, with 15 foot faces. Wages were \$3.50 for 9 hours.

The contract price for excavating solid rock in trenches 3x9 feet deep in the city of Spokane, Washington, was \$4.75 per cubic yard. This rock is a basalt of extreme toughness, and requires an excessive amount of drilling and blasting. The contract price for the same work in open cuts in street work was from 90 cents to \$1.25 per cubic yard. The cost to the city for removing gravel in the same size trenches was 90 cents to \$1.00 per cubic yard. Wages are \$3.00 for 8 hours, for city work. The contractors figure 20 per cent of the cost consists of overhead charges, interest and depreciation, and 6 per cent tax for workmen's compensation.

Open cuts made at Bingham, Utah, in weathered limestone and quartzite and slide rock, under the direction of the writer, cost 80 cents per cubic yard. Prospect tunnels in the same formation cost \$4.00 to \$6.00 per foot. Miners' wages were \$3.25 for 8 hours.

Hand placer work is cheaper, on the whole, than the same kind of work on lode claims, which is to be expected from the nature of the material which is handled in each case. The

formation of placers consists of stream gravel, sand, or clay, with an occasional boulder, and in some cases cemented strata. Hand placer excavating is straight pick and shovel work, except where boulders are encountered. In hand sinking on many placer properties, the amount of water which has to be bailed or pumped out is the greatest factor in determining the cost, and quite often the quantity of water prevents sinking entirely. In many places cemented strata are entirely absent, and what boulders are found are near bedrock and need not be moved in prospect work.

By considering how much gravel a man can handle per shift, and his daily wage, it would be possible theoretically to arrive at the cost of most placer excavations. Byrne, on page 202 of his *Inspector's Hand Book*, gives the average amount of material a man can loosen per hour with a pick as:

Clay or cemented gravel.....	1 cubic yard
Loam or loose gravel.....	2 to 3 cubic yards
Sand	4 to 6 cubic yards

On the same page he gives the average quantity a man can shovel per hour with a limit to the cast of 6 feet vertically and 12 feet horizontally, as:

Rock	1 cubic yard
Clay or heavy soils.....	1.7 cubic yards
Loose earth or sand.....	2 cubic yards

By taking Byrne's figures of $2\frac{1}{2}$ cubic yards per hour for loosening gravel, and of 1.7 cubic yards per hour for shoveling, a man, in an 8-hour shift, could excavate a trifle over 8 cubic yards of material. By allowing, for miners, \$3.50 for 8 hours, the cost per cubic yard would be 44 cents. This yardage agrees fairly well with other authorities, such as Gillette and Trautwine.

On placers, the cost of open work or trenches up to 7 feet deep, with little or no water, varies from 40 cents to \$1.00 per cubic yard, depending upon the nature of the material and the price of labor. Timbered prospect tunnels in gravel cost generally from \$4.00 to \$6.00 per linear foot. The cost of a 10 foot shaft, with little or no water, is generally taken as being \$10. Frozen gravel is not taken into consideration.

Trenches in city streets, particularly in a mountainous

country, are quite often in material similar to that found on placers. Costs are generally kept fairly close on this work, and in similar material can be used as a basis of comparison for placer work.

At Missoula, Montana, it costs the Missoula Light & Water Company an average of 36 cents per cubic yard to do the excavating for city water trenches 2x6 feet deep. The work is done by day labor, with wages at \$3.00 for 8 hours. The material moved is almost entirely wash gravel, with an occasional hardpan.

The Great Falls Water Company, at Great Falls, Montana, in excavating for city water pipes, moved 89 per cent earth, 5 per cent solid rock and 6 per cent loose rock at an average cost of 34 cents per cubic yard. Wages were \$2.25 for 10 hours.

S. Lefevre, in his article in the February Bulletin of the American Institute of Mining Engineers, gives the cost of surface excavations at Mineville, N. Y., in hardpan and boulders at 80 cents to \$1.00 per cubic yard. Wages for this kind of work are about \$2.00 for 10 hours.

Well diggers sink 5x5 feet wells up to 30 feet in depth on the Missoula flat, at Missoula, Montana, on contract, at \$1.50 per foot including placing, but not cost, of timber. Below 30 feet the cost increased. The flat is an old river bottom, and consists mostly of river gravel.

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

THE ASSOCIATED ENGINEERING SOCIETIES OF ST. LOUIS —A REVIEW

By A. P. GREENSFELDER,
MEMBER OF THE ENGINEERS' CLUB OF ST. LOUIS.

The Association of Engineering Societies of St. Louis was tentatively formed in 1911 and has been growing in strength ever since. Effective July 1, 1914, revised joint regulations were adopted in order to codify certain relationships which had gradually been formed and to define more clearly privileges of the constituent clubs and the duties of their officials.

Copies of these revised regulations have been eagerly sought by engineering societies throughout the country with the result that the September issue of the Journal containing a copy has been nearly exhausted. In order to supply the continuing demand the regulations are reprinted, following this article, and this review, after one year's activities, is written in an attempt to answer various questions which have been submitted to the local secretary by organizations contemplating the formation of similar associations.

In general the St. Louis Association has worked out splendidly. It has grouped the engineering activities of the community into a harmonious, enterprising and purposeful whole. It has eliminated petty jealousies, misunderstandings and friction between the five single societies. Each struggled to work out its individual existence and tried to justify its formation by soliciting new membership into its particular fold at the sacrifice of its neighbor. The amalgamation has not only eliminated these practices in the constituent societies, but a far more important object has been accomplished for the engineering profession as a whole, and that is the appearance before the press and public as a united technical group capable and willing to do its share in the development of civic spirit in its community. This public feature has developed speedily and the Joint Association has been repeatedly called upon to express its opinion or aid in solving a number of current municipal problems. Such actions, taken only after investigation and deliberation, have done much to arouse the dormant civic spirit of the

engineer, the lack of which has called forth justifiable criticism.

For purposes of purely presenting the analysis of engineering society government, it will perhaps be best to comment upon regulations themselves as they are divided into articles on management, meetings, dues, services and revisions. This review hopes rather to portray the spirit of the regulations and their intent than any letter of the law.

Government.

The election by each society of its two representatives serving alternate two year terms on the Joint Council will give the governing body a truly representative spirit capable of pursuing a consecutive policy. The idea of having on the Joint Council at least one of the governing committee of each society is to insure the spirit of the association being transmitted directly. In practice each of the affiliated societies has elected its president as one of the councilors, and each of these men upon whom has devolved the leadership of his group brings to the council direct their ambitions and problems which the association can often further and aid, or if they cannot co-operate therein, at least can prevent misrepresentations of purpose, conflict of dates or duplication of methods. The requirement that at least one councilor of each group should be a member of the Club as well, is no hardship, and is bound to insure that co-operative spirit which individual interest in both sides will develop.

The officers of the Club serving in similar capacities for the Council is merely to eliminate duplication of machinery to enable prompt call of meetings when necessary and to expedite procedure at such meetings by reducing time usually consumed in explanations. Section three has in mind merely that fairness implies that a quorum of the Council or any action thereof should be by majority vote of a majority of the societies.

In order to prevent hasty action on local public affairs and remove the possibility of seeking concurrence in unwise measures or to promote selfish ends, the Council is made the investigating group. Their printed recommendations in the call for the joint meeting to consider the impending question serves to educate the members beforehand and to arouse their

interest. If the subject is not deemed of sufficient importance for a referendum it may be disposed of at the joint meeting. In anticipation of cases arising where individual members may, because they are employes or for other reasons, differ from the decision of a majority of the profession, possible embarrassment is avoided by enabling them to have their signed votes so recorded. Public misrepresentation of the action of the Association is avoided by reciting the actual summary of the ballot.

Action on public affairs of national importance, it is thought, should be merely advisory or indicative of local sentiment, and for fear of possible embarrassment to the National Engineering bodies, the matter should be deferred to their judgment, rather than have the local section rush into print in haphazard fashion. This plan does not, however, throttle initiative on the part of any local section, for if they choose they may have the merits of their suggestions tested by the local profession as a whole, before submission to their national executive committees. This method of handling national public affairs should tend also to prevent action upon solicitations of clubs in other cities or states, which in itself is questionable, due to the practical impossibility of securing facts on both sides of a question wherewith to formulate judgment for a proper and intelligent indorsement vote.

Engineers even at this age of civic righteousness have not been unanimous as to the wisdom of united action on public matters. It would seem, however, to be beyond question that if decisions are made with the intent of publishing same for the influence possible upon public opinion, then such decisions, while they should be timely, should endeavor to merit respect by thorough investigation, ample discussion and deliberate vote. Failure to always be right as proven by subsequent events need not discourage engineering bodies, for progress is founded on failures, but to fear the responsibility is cowardly.

Meetings.

A minimum number of meetings are assigned each constituent society to conduct and arrange the program. It has been found that this obligation is a function which serves to keep each group alive and is a healthy incentive to offer good

topics and informed speakers. Also nothing is so sure a cure for destructive criticism as to force the critic to produce something better. This applies to groups as well as to individuals, and serves through loyalty to keep up attendance of the wavering. It is of course important that the total number of joint meetings should not be too great if it is not sought to discourage membership in the local club which caters to general engineering interests in the community rather than the specialized technical work of a local branch of any one national society.

It seems to be an assured fact, and the need being more and more universally felt, that the local interests of engineers for themselves as well as the community in which they are citizens, is best served by a local club comprising engineers of all branches. A statement to this effect was deemed of sufficient importance to be definitely included in the regulations as Section 5 of Article 3, and prevent confusing the issue between the local club formed for combined general, local technical and social purposes and the local branch of any national society formed primarily for the protection of the interests of the members of that particular group. It is so important that this distinction shall be clear that numerical strength, which is purely an item of time and relation, should absolutely have no bearing in the matter. The local club with its broader local purpose, is therefore the one around which it is natural for an association of societies to gather. As general leader the club must assume the function of true leadership, which involves the undoing of disparaging comparisons and the eliminating of petty jealousies which may appear among the constituent societies or their officers.

It is not essential that the local club be possessed of the club quarters or material facilities of the various groups, or have any property at all for that matter, but it must assume the role of host on all occasions and be so considered. To make this an actual fact, therefore, the club officers should serve as council officers, and the dual president should open all joint meetings, conduct joint business and then call for the chairman of the society presenting the program of the day.

Joint, Party and Individual meetings have been found to be the proper distinction for various meetings, and Joint and

Party members as defined have equal benefits and share equally in their cost.

The problem of Party meetings may require especial attention in each community, but in this particular case it is based on the fact that each affiliated society has at least fifty members. Unless they offered desirable technical meeting programs they would not be sustained by their own group, but if the subjects were of interest to their own members they would probably be so to members of the local club, which increased attendance seems to have really justified. Only one of the four affiliated societies holds technical meetings other than its joint meetings twice a year, and this particular society is compelled to hold monthly meetings to hold its national charter. In this case the Club felt sufficiently hospitable to offer its rooms at cost to this "party" and thus tend to make the club a center of all engineering activities in the city.

Costs.

The question of cost division is usually conducive to much argument, but casting aside all selfish advantages and motives, that division is the only fair one which is based on equal opportunity. If a club is desirous of joining an association at all it should surely be willing to pay its share of the actual cost of a meeting based on its pro rata of resident members in good standing on the list of its secretary who have the opportunity of attending that meeting. This puts each society and each member thereof on a self-respecting basis and that is a good mental attitude to be in when one goes to a meeting of engineers who in writing specifications claim the arbitrary and almost holy prerogative of the Chief Justice.

It may be well to emphasize the term actual cost as differentiated from extra cost. When this association was formed four years ago the Club undertook to be hospitable by offering its rooms free of cost for joint meetings and merely charged the conducting society the cost of printing and postage of the meeting notices. This generous procedure, while it undoubtedly served as an inducement to the affiliated societies to join the association, served materially to drain its own treasury. As the total membership grew the unfairness of the arrangement became manifest, and in the spring of 1913, two hundred and

forty-two members of the Club only were paying, with 133 other members of the Club who were also members of one or more of the affiliated societies, for meetings open to also 182 members of the four affiliated societies, but not supporting the Club. In 1915 these figures are 233, 188 and 216, respectively.

Although the Club leased its quarters by the year with light, heat and janitor service, and other expenses amounting to about \$600 a year, all of which cost the same whether the association met in its quarters or not, yet the eminent unfairness of such an arrangement including the additional cost of incidentals and printing was manifest to everyone. In the new scheme of things, a new secretary giving half of each day to the affairs of the Club was in mind. This increased expense permitted much better service, but as aid for general expenses is allowed three out of four local sections by their New York treasury it was seen that costs were not being equitably divided.

Bills are presented to the secretaries of the affiliated societies for its share of cost and these quarterly dues are met either by their national subsidy or local assessments. To protect those who are not only Club members but national members also, a proper reduction in their Club annual assessment is made. In 1911 the Club initiation fee was suspended for affiliated members who wished to join. This discriminated against a new member who joined the Club but was not affiliated with any local section. This created some criticism, and had also the practical effect of reducing new membership in the Club, but abnormally tempting new members to join the "nationals" first and take chances of joining the Club later. Just before the new regulations became effective July 1, 1914, over thirty affiliated members joined the Club in one week in order to save the initiation fee.

In order not to eliminate the open door policy completely the Club initiation fee is waived to affiliated members joining the Club within three years after joining such society. But reciprocally now the Club credits his initiation fee to any Club member who joins any affiliated society within a three year limit.

All Club initiation fees are properly set aside for real estate purposes in the form of a Furniture Renewal Fund for use in joint quarters. In order that the Club, as such, shall not be the loser by one of its members joining a national society

the local section assumes to repay his Club initiation fee within five years if desired in order not to make the sum too burdensome. This spirit of reciprocity and frank avowal of purposes in Section 6, Article 4, has gone a long way to clear an atmosphere often rendered hazy by over-zealous membership committees. The result of this union has demonstrated to all concerned the one fact that the membership in all societies has increased and is so continuing due to broadened acquaintance, better fellowship and more frequent contact.

Service.

In general the spirit of service of each to all is working out splendidly. Duplications of secretary service, printing and employment are eliminated with corresponding savings in cost.

A combined year book has put the associated societies before the public as a whole, enabling each member to be in the local engineering directory, and permitting the societies to compare their procedure and activities.

The courtesy of exchange of publishing privileges of papers and discussions is arranged, and stenographic and lantern service provided.

Refreshments for the cheer of the inner engineer are not prohibited, and "free lunch" may be offered whenever the spirit moves any society. Smokers have been known to display signs "Standing Room Only" and seem to be very popular features.

Revisions.

The regulations as drafted have not been made iron-bound in any sense of the term. In fact the feeling of its framers was just the opposite. Amendments and suspensions are readily enabled and societies are urged to remain in the union not so much by contract as by their mutual willingness to help assume the white man's burden, and gain the resultant advantages and benefits.

It is triumphantly stipulated that the regulations shall be responsive to the needs of the day and that if conditions do not change for the better every five years engineering schools should be investigated and some official funerals be inaugurated.

In truth, the regulations seek to automatically annihilate "Constitutionalists" so completely that if there must be sides on topics of the hour that they be discussed only by the two surveying engineering parties, the "Progressives" and the "Radicals."

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

REGULATIONS OF THE ASSOCIATED ENGINEERING SOCIETIES OF ST. LOUIS

Composed of
The Engineers' Club of St. Louis
St. Louis Association of Members of the American Society of
Civil Engineers
St. Louis Branch, American Society of Mechanical Engineers
St. Louis Branch, American Institute of Electrical Engineers
St. Louis Branch, American Society of Engineering Contractors

[Last Amended by the Joint Council, April 4, 1914.]

Article I—Name.

Section 1. The name of this Association shall be the "Associated Engineering Societies of St. Louis," and its object shall be the unification and co-operation of the engineering societies of St. Louis.

Sec. 2. With the Engineers' Club of St. Louis, the local organizations of the American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers and American Society of Engineering Contractors, are charter affiliated societies of this Association. Local organizations of fifty or more members which are branches of other national engineering bodies are eligible for affiliation.

Article II—Council.

Section 1. The affairs of the Association shall be conducted by a Joint Council consisting of the President and two Junior Past-Presidents of the Engineers' Club, together with two other councilors chosen by each of the affiliated societies, one each year for a term of two years, at least one of whom shall be a member of its governing committee, and at least one a member of the Engineers' Club.

Sec. 2. The President, Treasurer and Secretary of the Engineers' Club shall act in similar capacities for the Council. In the absence of its President, the Council shall choose a chairman. The Treasurer shall collect all dues. The Secretary shall mail notices at least two days in advance of all meetings, and record the minutes thereof.

Sec. 3. Meeting of the Council shall be held upon call of any two Councilors, but not less than quarterly upon call of the President. Five members, representing at least four societies, shall constitute a quorum. The ye and nay vote of

members on all questions shall be recorded. Decision of the Council shall require at least five votes representing at least three societies.

Sec. 4. The Council shall have jurisdiction over all matters of joint interest in so far as their decisions shall not conflict with the rules of the various societies. Upon petitions for affiliation of other societies and special financial matters, the recommendations of the Council shall be printed in the notice for the next joint meeting of the Association, when a three-fifths vote shall be necessary to decide the question.

Sec. 5. The Societies in the Association shall act jointly on all local public affairs presented for consideration to any one or more of the societies. Such questions shall be referred to the Council for their recommendation, which shall be printed in the notice for the next joint meeting. Such meeting shall by majority vote decide the advisability and form of a referendum ballot returnable in ten days, when the yea and nay ballots shall be counted, and if signed shall be so recorded by the Secretary. If such meeting shall decide against a referendum, a two-thirds yea and nay vote shall be necessary to decide the question. The result in either case, if made public or published, shall recite the date, the number of votes for, against and not voting or attending.

Sec. 6. In national public affairs, the recommendations of the Council, if any, shall be printed in the notice for the next joint meeting, when a three-fifths yea and nay vote may decide to refer the question to the consideration of one or more national engineering bodies through their affiliated societies.

Article III—Meetings.

Section 1. Each society shall arrange two technical "joint meetings" per calendar year, in which all other societies shall participate. One joint banquet annually shall be, and other joint meetings may be arranged by the Council. Resident members in good standing on the lists of the secretaries of the societies participating in joint meetings shall be known as "joint members," and as such shall be entitled to all the benefits of such meetings and shall share equally in their cost.

Sec. 2. Each affiliated society shall arrange all its technical meetings other than joint meetings as "party meetings."

In party meetings, only the affiliated society and the Engineers' Club shall participate. Resident members in good standing on the list of secretaries of the societies participating in party meetings shall be known as "party members," and as such shall be entitled to all the benefits of such meetings and shall share equally in their cost.

Sec. 3. Each individual affiliated society may arrange non-technical "individual meetings," in which it alone may participate.

Sec. 4. The auditorium of the Engineers' Club shall be available for all joint and party meetings. At joint meetings, the order of business shall be as follows: Call to order by President of Council; reading of Council minutes; joint business; call to chair of presiding officer of conducting society; new business of the society; presentation of technical subject; joint discussion; adjournment. The technical subjects at joint meetings shall exclude matters of meager interest, of careless preparation or of pure advertisement of commercial articles. At party meetings, the presiding officer of the conducting society shall officiate, and may conduct its regular order of business, but members of the Engineers' Club shall have the privilege of participating in the discussion of the technical subject. At joint and party meetings, members of the participating societies may invite visitors, who shall be permitted to discuss the technical subject.

Sec. 5. The Engineers' Club, having an auditorium, library, club rooms, employment bureau, weekly technical papers on local matters, entertainments, local monthly bulletin for news items, national monthly journal for the publication of papers, and the service of a paid secretary, for the engineers in the community who have united for their mutual welfare and who will further contribute for professional and social purposes, is recognized as the parent engineering society of St. Louis. The Engineers' Club therefore reserves the right to hold technical and social meetings and excursions with or without participation of one or more affiliated societies.

Article IV—Dues.

Section 1. General disbursements of the Engineers' Club shall include for the year 1915, the five following items: (1) Assistant Secretary printing service at four dollars per meet-

ing notice, and program service at ten dollars per meeting; (2) printing and postage at two cents for each meeting notice to joint and party members; (3) rental of auditorium at ten dollars per meeting; (4) publication of joint Year Book at forty cents per joint member; (5) furniture renewals. The Council, in January, for each current year, shall equitably proportion all general expenses among the societies according to their pro rata joint and party members. Special expenditures of the Club shall include stenographic service, lantern slides, refreshments and individual service. The Treasurer of the Council shall submit such general and special expense based on the total number of joint and party meetings during the past quarter.

Sec. 2. The Club shall pay quarterly its pro rata share for its joint and party members who are not members in any affiliated society. Each affiliated society shall pay quarterly its pro rata share for all its joint and party members. Joint and party members of the Club who are also members of one or more affiliated societies shall have their annual Club assessment reduced such pro rata share for each such membership. If any affiliated society decides that its members who are also members of the Club prefer not to avail themselves of such reduced Club assessment, any such amount paid to the Treasurer of the Club will be credited by him to that affiliated society.

Sec. 3. The Engineers' Club shall charge each affiliated society fifteen dollars for rental of auditorium for each individual meeting held therein, which charge shall include cost of the individual notices.

Sec. 4. The Engineers' Club may for a time waive its initiation fee to new members of an affiliated society who join the Club within three years after joining such society, and during that time shall credit his initiation fee to any new member of the Club who joins an affiliated society within three years after joining the Club.

Sec. 5. The Engineers' Club shall set aside all initiation fee as a "furniture renewal fund," for reconstructing, refurnishing or moving joint quarters. It is recognized that affiliation with the Engineers' Club will be a strong factor in increasing the membership of each affiliated society. Therefore, until the Club shall waive its initiation fee, or make it the same for all new

members, each affiliated society, in order not to be recipients of special privilege, shall pay a share into such fund. Such sum, or "Quarters' Fee," shall be the Club initiation (at a rate not less than two dollars per year each) for such members of the Club joining that affiliated society within their three-year limit. This fee shall not exceed twenty-five dollars in any one year for any affiliated society.

Sec. 6. In furtherance of the spirit of the Engineers' Club which prompts it to offer its reception rooms free in order to promote local united engineering activities, each affiliated society shall encourage its members to join the Club in order that they may gain social relationship with, local professional standing among, and personal friendship of fellow engineers in St. Louis. The Engineers' Club shall encourage its members to join a national engineering body through an affiliated society.

Article V—Service.

Section 1. The Engineers' Club shall print and post a joint Year Book, and all notices of joint and party meetings and individual meetings held at the Club. Individual notices shall be sent only to members of the issuing society, party notices to party members, joint notices to joint members, and the Year Book to all members of all societies. The Year Book, in sections, shall contain lists of officers and committees, rosters, condensed reports of officers, programs, rule of each society and its associations, statistics and such other matters as the Council shall decide, provided the Club shall be furnished the necessary data by February 1st.

Sec. 2. Papers and available discussions presented at joint or party meetings shall have consideration for publishing in the national Journal of the Association of Engineering Societies. Available discussions of papers at joint or party meetings by members of the Engineers' Club may be printed with such papers if published by an affiliated society. Stenographic services, lantern slides or special apparatus desired at any meeting may be furnished by the Engineers' Club, but shall be paid for by the society requesting the same.

Sec. 3. Refreshments served at any joint or party meeting may be furnished by the Engineers' Club, but shall be paid for by the society requesting same.

Sec. 4. The attendance of the paid Secretary of the Engineers' Club shall be available gratis for joint or party meetings, but the preparation of individual minutes or his special services at other times shall be paid for by the society requesting the same.

Article VI—Revisions.

Section 1. An affiliated society failing in its obligation shall be notified in writing by the Council, and if such obligations are not met within three months thereafter, such society may be dropped from this Association, upon vote of a majority of the Council in letter-ballot. Any society may withdraw from the Association three months after service of written notice to the Council, provided it is not financially in arrears.

Sec. 2. These regulations may be amended or suspended by the Council by submission in writing and majority vote at any meeting thereof, and then approved by a three-fifths ye and nay vote at a joint meeting, the question having been stated in notice of that meeting.

Sec. 3. These regulations shall become effective July 1, 1914, if adopted by the Engineers' Club and by at least two of the affiliated societies. They shall be revised as a whole at least every five years by the Council for approval by a three-fifths ye and nay vote at a joint meeting, the revised regulations being printed in notice of that meeting.

OBITUARY

George A. Griggs,

ACTIVE MEMBER OF THE MONTANA SOCIETY OF ENGINEERS.

The Recording Angel has opened his book and closed the account of one of our members, George Albert Griggs, the last entry being dated at Springfield, New Jersey, February 12, 1915.

Born in Charlestown, New Hampshire, August 9, 1859, he graduated from the Worcester, Massachusetts, Military Academy in 1877. His inclination was to follow the naval profession. With that end in view he took the examination for Annapolis, which he most creditably passed. Failing health prevented him from pursuing these studies. He accordingly entered commercial life, filling numerous positions of trust and responsibility in banking circles in Hornellsville, New York, for six years.

He then came to Billings, Montana, where he became connected with various banks, and was elected mayor of that bustling town three times. He served as captain of the local company of the First Regiment, N. G. S. M.

He came to Butte in 1904, in charge of the Yegen Bank, remaining with these interests until his retirement in 1914.

Mr. Griggs was descended from a family of mechanics and inventors of note. He inherited their spirit and has contributed to every-day business life numerous labor-saving devices. He himself was an inventor of no small renown.

Quiet in demeanor, of a retiring address, a keen student of engineering, a man of sober thought and decisive action, he acquitted himself a good citizen and a loyal friend, bettering the world by his short sojourn, and having left a cherished memory to those who knew him.

A. F. MUNROE,
F. T. DONAHOE,
A. V. CORRY.

OBITUARY

Arthur W. Bower,

ASSOCIATE MEMBER OF THE MONTANA SOCIETY OF ENGINEERS.

Arthur W. Bower was born at Pleasant Valley, Dutchess County, N. Y., in 1847. Died at Mount Vernon, N. Y., February 21st, 1915; age, 68 years. He was a graduate from the Civil Engineering Course of the Rensselaer Polytechnic Institute of Troy, N. Y. Following his graduation he was retained as professor in physics for several years. In 1880 he resigned from this position and came to Montana, where he engaged in sheep growing with his two brothers, this partnership continuing until 1908, when they sold their interests and retired from business.

The firm of Bower Bros., of Stanford, Montana, of which Arthur W. Bower was senior member, was one of the largest sheep companies in the State. Because of their business integrity and recognized worth as men, this firm gained a very high standing in the business world.

After retiring from business Mr. Bower resided for some time in Great Falls, and it was during this period in the year 1909 that he joined the Montana Society of Engineers as Associate Member. Later he moved to Mt. Vernon, in his native State of New York, where he spent the last few days of his life.

Mr. Bower was a man of a quiet and retiring disposition, and never sought any public honors. He found his greatest pleasure in study and research, and that great educator, intelligent travel. He and Mrs. Bower traveled extensively, having visited many foreign lands, as well as nearly all parts of our own country. This, together with his extensive reading and familiarity with world affairs and his natural gift as a conversationalist, made him a most charming acquaintance.

He was a refined and cultured gentleman, a man of high ideals and of sterling character. His passing removes one of Montana's staunchest friends, and one in whose death all who knew him will experience a keen and sincere sense of loss.

C. W. SWEARINGEN,

J. H. KLEPINGER,

W. T. BURNS.

Editors reprinting articles from this JOURNAL are requested to credit the author, the JOURNAL OF THE ASSOCIATION, and the Society before which such articles were read.

ASSOCIATION OF ENGINEERING SOCIETIES

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This Association is not responsible for the subject-matter contributed by any Society or for the statements or opinions of members of the Societies:

THE INVESTMENT BANKER AND THE ENGINEER.

By CHARLES A. HOBEIN.*
MEMBER OF THE ENGINEERS' CLUB OF ST. LOUIS.

[Read before the Club, April 28, 1915.]

In discussing this subject, the paper will deal briefly with the work of the investment banker, touching on some of the fundamental principals of investment, but considering only stocks and bonds. The discussion will then deal with the main work of the engineer in the investment business which has to do with the buying of securities and investigation of projects.

The engineer has a place in practically all financing, and is mentioned in nearly all mortgages. The mortgage usually states that before the corporation may issue bonds they must present to the trustee a certificate signed by a competent engineer stating that money has been spent and the improvements have a value equal to the amount of bonds which the trustee is requested to authenticate.

Work of the Investment Banker.

Investment banking consists of the buying and selling of investment securities. Broadly, the work consists of handling investments of all kinds, real estate loans, stock, bonds, etc. Real estate loan business is nowadays largely handled by individuals and corporations dealing in real estate. However, investment

*Engineer with John Nickerson, Jr., Investment Bonds.

bankers often sell bonds secured by apartment houses, hotels, office buildings and real estate.

Fundamental Principals of Investments.

Strictly speaking, an investment (considering bonds or stocks) consists of the purchase of a bond. Capital stock surrounded with proper safeguards can sometimes be considered on an investment plane. In speaking of the capitalization of a corporation, the terms "stocks and bonds" are oftentimes used rather loosely and quite often are so used as to convey the idea that the two securities are more or less of a similar nature.

Just to outline the difference, we may say that for a pure investment a person is largely confined to a bond obligation, bonds being defined as certificates representing a loan secured by a mortgage, or otherwise, and having a fixed date when the loan becomes due.

Stock is in the form of a certificate representing the capital of a company divided into shares. The certificate usually bears what is known as the par value. This question of par value will be referred to later. The certificate of stock carries no obligation to repay to the purchaser the par value and has no maturity.

Bonds.

Roughly, bonds are divided into two classes—Government bonds and corporation bonds.

Under Government bonds we may include bonds of the United States Government and various classes called "little government bonds," meaning bonds issued by municipal corporations, such as street improvement bonds, drainage bonds and irrigation bonds. Irrigation bonds are often the obligations of corporations. Under corporation bonds we have industrial, railroad and public utility bonds.

Government Bonds.

A Government bond is really not a bond in the strictest sense of the definition, for the reason that the obligation of the Government is not secured by a mortgage on any specific property. The bonds have a fixed date of maturity and bear a specified interest rate. Some Government bonds do not have a definite maturity.

This type of bond has sometimes been called government stock. The State of New York, at the present time, has a great

many bonds outstanding under the name of corporation stock and this designation is used a great deal at the present time in Canadian cities.

Municipal bonds are usually considered as the highest and safest form of investment. However, we do not have to go back very far in history to see that the value of our United States Government bonds have fluctuated almost as sharply as have the obligations of some of our corporations. In a few words I wish to point out, from the financial history of our government, how our government bonds have several times been jeopardized by the failure of our credit, and how the value of these securities have been affected.

On August 2, 1813, the United States Government 6 per cent bonds sold as low as 65. November, 1860, the national election was a great shock to the credit of this nation. The Government issuing bonds about this time had to fix the interest rate at from ten to twelve per cent in order to sell them at a price equal to their par value.

On February 8, 1861, the Government sold six per cent bonds at 89. On December 30, 1861, the Government suspended specie payment and this repudiation continued for practically fourteen years, this meaning that the owner of United States Notes or Greenbacks could not secure coin in exchange for them.

Within the memory of all of us there has been a period when our Government credit suffered very severely. In 1890, at the beginning of the Cleveland administration, Congress passed a law for a new emission of legal tender notes (greenbacks). These notes were issued in payment for silver bullion which was stored in the Treasury as security. The notes were payable in either gold or silver at the ratio of approximately sixteen to one, the idea being that by this means the Government could sustain a parity at this ratio between gold and silver. Silver declined in value and immediately demands were made upon the Treasury for the payment of these notes in gold. Gold began to leave the country and a severe panic ensued.

During this period the Government four times sold bonds in order to replenish the gold reserve of the Treasury.

Up to 1893, these legal tender notes were reissued, as redeemed, in either gold or silver. About that period, the notes were cancelled as redeemed and the silver released was coined.

Since 1900 none of the legal tender notes of the issue of 1890 have been reissued unless the purchaser paid gold.

We still have outstanding \$346,000,000 in greenbacks. No one questions that the United States notes are equal to the par value printed upon their face. They pass from hand to hand the same as gold. The reason is that the Government has sold \$362,000,000 in bonds, in other words, the Government has borrowed this much money to bolster up the Treasury so that it can make a showing sufficient to be able to redeem the greenbacks at any time. These bonds have cost the Government \$362,000,000 in interest which could have been saved if the greenbacks were retired.

At the present time our Government Treasury is showing a deficit and if our credit is not to suffer, steps must be taken to put the Government in a position where the expenditures are not greater than the receipts.

"Gallatin formulated the true principles of debt reduction in 1800, in a debate upon the Sinking Fund when he observed (with a side reference to Hamilton): 'I know of but one way that a nation has of paying their debts, and that is precisely the same that individuals practice, spend less than you receive and you may then apply the surplus of your receipts to the discharge of your debts.'"

I understand that a bill was introduced at the last session of the legislature of the State of Arkansas which would have postponed the payment of the obligations of all municipal corporations, and the State, for a period of six months. While this would probably be unconstitutional, still it affects vitally the credit of the State.

The St. Louis Republic on February 24th contained an item relating to \$235,000 bonds issued by Dallas County, Mo., forty years ago for the construction of a road. The panic of 1873 put a stop to construction. The County paid interest on the bonds for a couple of years and the Judges since have refused to make a levy on the tax payers for the payment of interest and principal. Steps are now being taken to compromise the claims. The indebtedness, due to the interest, now amounts to about \$2,000,000 and the case is pending in the Supreme Court of the United States.

These facts have been brought out to show that care must

be used in the purchase of Municipal obligations as well as in the purchase of any other form of bond.

Capital Stock.

The purchase of stock of a corporation can hardly be considered as the purchase of an investment. An exception to this statement might be the purchase of a high grade preferred stock, the dividend on which is amply earned by the company, or the purchase of a stock which is guaranteed by another strong corporation.

In most states the laws require that stock shall be issued for some consideration, which shall be equal to the par value of the stock. A person in buying stock buys a share in the assets and earnings (or losses) of a corporation.

After the corporation is once formed and the stock is issued, the par value is of very little significance. There is no obligation on the part of the company to ever pay to the stockholder an amount of money equal to the par value of his stock and we all recognize that after stock is once issued the value of the stock may greatly increase or may decrease in value.

A stockholder is simply a partner in the business. The State of New York has recognized the fact that par value is of little significance and corporations organized under the law of that State can now issue their shares with no par value, which appears to be a very sensible provision.

Buying of Securities.

The work of the investment banker is not confined to the selling of securities. One of the most important parts of the work is that of the purchase of the proper safe investments. The investment banker must first assume the obligation before he is in a position to sell the bonds to his client. Here the question of credit forms the basis of the investment banker's work. With good credit the investment banker can make the bonds, which he purchases, the basis for a bank loan, pledging the bonds purchased as security.

The engineer finds his chief work with the investment banker in the purchase of securities. His report must cover the field quite completely.

In addition to the engineer's report, there is required the report of a certified public accountant. This indicates the accuracy of the corporation's books. The legal work necessary is also

quite an item before bonds can be issued. This covers the investigation of titles and franchises, the drawing of the mortgage or deed of trust, the proper issuance of the bonds, etc.

Engineers' Work With the Investment Bankers.

My work in the investment banking business has been largely confined to public utility securities. This will explain why the tables and work described are limited to this class of security.

In general, engineers find their usefulness in the investment banking business, confined to the occasional reports which they are employed to prepare dealing with the investigating of projects or securities. Just here I want to call your attention to the fact that the engineer's report must cover the entire field.

The engineer in order to prepare a report of value to a banker must have considerable knowledge of accounting methods so as to investigate the books of a corporation, to ascertain the book value of the property, the methods of handling depreciation accounting, to ascertain whether the earnings statement is properly made up, whether the proper deductions have been made from earnings by estimating the interest on the debt and the payment of dividends. He must be able to understand the accounting methods employed in consolidating various corporations.

The engineer must have a broad knowledge of business conditions in the territory and be able to analyze the prospects for future business. He should have some knowledge of the legal questions which interest corporations, so as to examine articles of incorporation, franchises, and the operation of the property under the restrictions of the various liens.

The entire analysis and study calls for the application of various economic principles, all of which necessarily entail a general understanding of the question of credits, exchange, banking, rent, labor problems, etc.

Then there is the necessary engineering knowledge, which deals with operation of public utility properties, the theories of valuation and cost data. Engineers' reports are often required in preparing for the purchase of municipal bonds, particularly in irrigation projects, drainage projects and the issuance of bonds for the building of roads, sewers, bridges, etc. In municipal work most questions are of a legal nature and the lawyers are those who are consulted in investigating this class of security.

It is surprising to find the apparent lack of care with which many engineering reports are prepared. I may say that errors are very common and statements are not clearly made. This is particularly true in reports issued by engineering corporations of great size where the work is more or less delegated to subordinates. Many reports which come to hand do not reflect credit upon the engineering profession.

The amount of information which is available to one who seeks to analyze corporation statements is amazing. Various publications devoted to the analysis and publicity of corporation data are very complete. There are manuals of industrial corporation railroad and public utilities issued by two or three firms; books on the analysis of railroads and public utilities, special analytical letters published from time to time, statistical information gathered together and analyzed from the reports made to the Interstate Commerce Commission at Washington showing the securities owned by the railroads, giving the cost value and the book value as carried on the balance sheet of the road, publications showing the various securities held by the large investors in the country, such as insurance companies, railroads, etc.; all the various reports of the insurance commissioners giving information relative to our insurance companies. The publications of the various state public service commissions giving their decisions, etc.

With all this information it seems that the student of security values and property values should not go far wrong in analyzing these matters.

Public Service Commissions.

Before passing on to some tables which I wish to show, I wish to say a word regarding the work of the state public service commissions and how this should be interesting to engineers. We complain about the fact that very few engineers are appointed on these commissions, yet it seems to me that the engineers themselves are overlooking a great opportunity for usefulness in connection with the commission work.

The public service commission are not courts and it is not necessary that a person presenting a case before a public service commission should be a member of the bar. The commissions want to get at the facts. It appears that the work of presenting

cases before the commission should be largely carried on by engineers. Instead of this condition, we find that the lawyers have taken this work over and any who have heard many of the technical questions presented to the commission realize that many simple problems are made complex through improper presentation by lawyers.

Many public service corporations do not obtain their rights before the commissions for the reason that their cases are improperly presented and all the facts are not brought out. It appears logical to me that work of this kind should be largely in the hands of engineers.

Unit Analysis of Public Utilities.

The tables herewith presented entitled "Unit Analysis of Public Utilities" were devised in order to make a rapid analysis of any bond issues using information which is commonly given in a bond circular which describes the issue. For this reason the units used have been chosen which make use of this information.

In these tables the corporation statements have been reduced to a common denominator. For instance, the gross earnings are compared by using four different units and so on. This puts the companies on a comparable basis. The figures must be judiciously used, for a company distributing natural gas would present an entirely different analysis from an artificial gas company shown on these tables.

GAS COMPANIES.

Company	Gross Earnings Per				Per Dollar of Gross Earnings				Per Dollar of Net Earnings				Operating Ratio		Fixed Charges Times are Earned		Bonds Per		Population Per		Thousands of Cu.Ft.Gas Per	
	Capita	Mile of Main	Consumer	1000 Cu. Ft. Gas	Bonds at Par	Pfd. Stock at Market	Com. Stock at Market	Capitalization as Shown	Bonds at Par	Pfd. Stock at Market	Com. Stock at Market	Capitalization as Shown	Operating Ratio	Times	Mile of Main	1000 Cu. Ft. Gas	Capita	Consumer	Mile of Main	Consumer	Cu.Ft.Gas Per	
EASTERN																						
1	2.63	2,540	20.00	1.12	5.21	0.63	2.64	8.48	12.50	1.52	6.32	20.34	0.58	1.44	1,330	5.85	13.75	970	7.50	17.80	2.34	
2	1.91	1,965	41.20	1.27	7.27	0.31	0.34	7.92	18.80	0.81	0.89	20.50	0.62	1.10	14,290	9.25	13.88	1028	21.00	32.40	1.50	
3	4.40	3,980	23.03	0.89	0.67	2.81	6.50	9.98	1.35	5.14	13.20	19.69	0.50	16.00*	2,670	0.60	3.00	902	5.25	25.80	4.94	
4	3.12	3,155	21.80	1.09	.....	0.68	3.74	4.42	.....	1.60	8.81	10.41	0.58	.....	.....	.....	.....	1009	6.98	19.95	2.86
5	3.28	2,840	20.55	1.25	.....	.....	6.34	6.34	.....	.....	20.70	20.70	0.70	.....	.....	.....	.....	865	6.27	16.40	2.62
Avg	3.07	2,896	25.32	1.12	4.38	1.11	3.91	7.43	10.88	2.27	12.38	18.32	0.60	1.27	6,096	5.23	10.21	955	9.40	22.47	2.85	
SOUTHERN																						
6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
7	3.88	3,370	45.00	1.36	3.13	2.46	1.64	7.23	7.55	5.93	3.97	17.45	0.58	.....	6,055	1.49	7.27	830	8.00	37.65	4.88
8	3.89	2,590	34.04	1.12	2.92	0.28	7.22	10.42	7.12	0.70	9.70	17.52	0.58	2.80	10,550	4.28	12.19	11.55	8.66	32.90	2.85	
9	2.47	2,130	27.48	1.14	6.43	.....	4.55	11.04	14.20	.....	0.99	15.19	0.54	2.33	13,880	7.44	16.04	11.00	8.67	30.00	3.45
10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Avg	3.41	2,697	35.51	1.22	4.18	1.37	4.47	9.56	9.62	3.31	4.88	16.72	0.56	2.61	9,521	4.12	11.72	10.44	8.46	31.51	3.17	
WESTERN																						
11	6.85	1,520	17.38	0.95	2.19	0.62	2.06	4.87	7.50	2.12	7.30	16.92	0.70	2.22	3,333	2.16	15.00	2.54	2.54	17.70	6.95	
12	4.72	2,270	31.55	0.84	3.55	1.27	4.25	9.07	7.15	2.56	8.55	18.26	0.50	3.00	8,102	3.00	16.78	6.66	483	37.50	5.60	
13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	2.55	1,630	21.20	0.98	7.08	1.30	0.34	8.72	15.40	2.82	0.74	18.96	0.53	1.25	11,546	6.90	18.00	8.22	638	21.10	2.58	
15	2.67	1,980	38.19	0.71	4.83	2.02	0.25	7.10	11.10	4.62	0.58	16.30	0.56	1.66	9,600	3.42	12.00	14.00	742	51.75	3.75	
Avg	4.19	1,850	27.08	0.87	4.41	1.30	1.73	7.44	10.29	3.03	4.29	17.61	0.57	2.03	6,711	3.24	15.16	8.68	556	30.85	4.17	
NORTHERN																						
16	8.50	4,813	29.90	0.77	.....	.....	7.42	7.42	.....	.....	23.60	23.60	0.68	.....	.....	.....	.....	.....	.....	.....	.....
17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18	5.97	5,050	29.20	0.78	3.49	.....	4.40	7.89	8.72	.....	11.00	19.72	0.60	2.81	17,650	1.75	13.68	4.75	808	37.07	7.82
19	6.72	4,735	51.20	0.93	3.07	.....	3.93	7.00	7.91	.....	10.00	17.91	0.61	2.33	14,550	2.89	20.70	4.90	845	37.70	7.63
20	2.88	2,702	28.80	1.39	1.14	.....	4.07	5.21	3.42	.....	12.20	15.62	0.66	6.00	3,090	1.59	3.30	10.00	938	20.69	2.06
Avg	6.02	4,325	34.78	0.97	2.57	.....	4.95	6.88	6.68	.....	14.20	19.21	0.64	3.71	11,585	2.24	14.64	5.66	773	34.07	7.12
MIDDLE WEST																						
21	3.59	2,285	27.99	0.82	3.70	.....	3.53	7.23	9.35	.....	8.89	18.24	0.60	2.11	8,500	3.05	13.31	8.00	637	34.90	4.35
22	6.15	2,840	27.40	1.01	2.00	.....	1.18	3.18	9.60	.....	5.39	14.99	0.78	1.55	5,960	2.12	12.98	4.50	462	26.90	6.06
23	6.32	5,025	31.80	0.80	4.60	0.56	2.54	7.70	9.06	1.13	4.85	15.04	0.48	3.50	23,180	3.83	29.62	5.00	795	38.40	7.60	
24	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
25	7.27	5,920	29.12	.....	3.33	.....	2.52	5.85	8.47	.....	6.33	14.80	0.60	3.14	1,530	0.36	16.01	4.00	818	.....	.....
Avg	5.83	4,017	29.08	0.89	3.41	0.56	2.44	5.99	9.12	1.13	6.37	15.77	0.63	2.57	9,792	2.34	14.54	6.10	735	30.05	5.05	
All Co.	4.27	3,167	29.84	1.01	3.80	1.17	3.47	7.35	9.36	2.63	8.20	17.61	0.60	2.50	8,771.9	3.33	13.55	8.06	7729	29.78	4.45	

*Not included in averages.
 Prices of stocks are as of Feb., 1913.
 Figures in most cases based upon reports for 1911.
 Unquoted stocks are valued by capitalizing balance for dividends.

ELECTRIC LIGHT AND POWER COMPANIES

Company	Gross Earnings Per			Bonds at Par	Pfd. Stock at Market	Com. Stock at Market	Capital as Shown	Per Dollar of Gross Earnings			Per Dollar of Net Earnings			Operating Ratio	Times Fixed Charges are Earned	Bonds Per			Population Per		Kilowatt Hour Mfd. Per				
	Capita	Kilowatt Capacity	Consumer					Kilowatt Hour Manufactured	Capita	Kilowatt Capacity	Consumer	Kilowatt Hours Manufactured	Capita			Consumer	Capacity	Kilowatt	Hours	Manufactured	Capita	Consumer	Capacity	Consumer	Capita
EASTERN																									
26	7.85	73.5	137	0.040	0.27	8.40	8.67	0.603	11.78	18.38	0.53	13.80*	20.9	0.0114	2.46	26.2	9.40	33.40	131	33.40	131	33.40			
27	6.21	53.5	127	0.037	0.74	4.77	5.51	1.600	11.00	12.50	0.57	2.96	40.5	0.0260	4.30	34.0	9.41	33.80	165	33.80	165	33.80			
28	4.70	86.1	138	0.045	0.87	4.01	4.88	2.370	10.50	12.87	0.62	2.88	72.1	0.0406	4.27	27.9	18.10	30.30	64	30.30	64	30.30			
29	4.72	47.0	75	0.047	1.22	4.42	5.64	4.100	15.00	19.10	0.75	9.90	56.7	0.0530	4.74	15.6	11.10	17.20	111	17.20	111	17.20			
30	6.63	62.0	98.5	0.031	0.34	6.27	6.61	0.650	12.00	12.65	0.47	3.60	33.4	0.0105	2.25	14.9	9.35	31.70	214	31.70	214	31.70			
Av'ge	6.02	64.4	115.1	0.040	0.69	5.57	6.26	1.864	13.26	15.12	0.59	4.83	44.7	0.0283	3.60	23.7	11.47	29.28	137	29.28	137	29.28			
SOUTHERN																									
31	6.80*	94.5	71	0.043	1.90	7.10	9.00	3.53	13.10	16.63	0.46	4.65	180.	0.0850	13.00	10.3	13.90	1666	154	1666	154	1666			
32	4.94	91.0	57	0.035	4.86	1.73	7.69	10.12	3.57	2.29	0.52	1.95	442.	0.1600	24.00	11.5	18.40	1630	142	1630	142	1630			
33	5.87	92.7	64	0.039	3.38	1.73	8.34	6.82	3.57	7.69	0.49	3.30	274.	0.1230	14.88	10.9	19.50	1648	148	1648	148	1648			
Av'ge	5.50	53.0	64.9	0.039	3.64	1.06	9.78	6.60	1.93	9.20	0.45	3.04	192.	0.1450	20.00	12.5	9.60	1645	139	1645	139	1645			
36	6.42	70.6	55.5	0.040	2.99	0.42	6.37	6.83	0.96	5.06	0.58	3.83	212.	0.1200	12.50	13.2	16.95	1385	104	1385	104	1385			
37	4.17	57.0	71.5	0.030	3.28	6.10	9.38	5.82	11.70	17.52	0.48	3.44	169.	0.0930	19.40	11.6	8.80	2420	208	2420	208	2420			
38	5.36	60.2	63.9	0.036	3.30	0.74	8.59	6.42	1.44	8.65	0.49	3.43	191.	0.1193	17.30	12.4	11.78	1817	150	1817	150	1817			
Av'ge	5.36	60.2	63.9	0.036	3.30	0.74	8.59	6.42	1.44	8.65	0.49	3.43	191.	0.1193	17.30	12.4	11.78	1817	150	1817	150	1817			
WESTERN																									
41	2.33	40.3	65.0	0.022	0.39	7.97	8.36	0.78	15.94	16.72	0.50	20.80*	160.	0.0890	28.00	8.4	5.60	2840	312	2840	312	2840			
42	7.72	44.7	33.2	0.037	2.93	1.89	5.07	7.20	4.59	6.11	0.58	2.83	168.	0.1120	17.20	5.7	5.7	3460	189	3460	189	3460			
43	5.83	49.3	89.7	0.025	4.55	0.81	4.54	9.90	7.93	1.41	0.43	2.62	274.	0.1180	22.30	18.5	10.20	3460	189	3460	189	3460			
44	4.90	50.2	89.7	0.025	4.55	0.81	4.54	9.90	7.93	1.41	0.43	2.62	274.	0.1180	22.30	18.5	10.20	3460	189	3460	189	3460			
45	5.19	45.1	62.6	0.028	2.94	1.35	7.46	6.27	3.00	9.04	0.52	2.56	201.	0.1063	17.12	10.8	10.93	3150	218	3150	218	3150			
Av'ge	5.19	45.1	62.6	0.028	2.94	1.35	7.46	6.27	3.00	9.04	0.52	2.56	201.	0.1063	17.12	10.8	10.93	3150	218	3150	218	3150			
MIDDLE WEST																									
46	6.32	53.0	86.	0.017	2.78	4.46	7.25	5.18	8.30	13.48	0.55	5.70	123.	0.0400	14.70	13.6	8.40	5000	367	5000	367	5000			
47	5.60	49.3	115.	0.029	6.25	1.88	9.75	13.30	4.01	3.46	0.53	1.58	307.	0.1820	35.00	25.2	9.50	3930	192	3930	192	3930			
48	4.70	47.7	115.	0.034	4.75	2.38	10.58	10.25	5.52	20.77	0.55	1.95	227.	0.1600	10.40	21.80	21.80	2000	163	2000	163	2000			
49	4.16	45.8	60.3	0.030	3.28	3.71	7.34	7.59	0.82	8.60	0.57	2.54	150.	0.0900	16.00	14.5	11.10	5100	217	5100	217	5100			
50	4.80	53.0	113.	0.022	4.45	3.84	8.29	9.72	8.40	18.12	0.54	1.93	238.	0.0980	21.40	23.5	11.10	5100	217	5100	217	5100			
Av'ge	5.22	49.7	93.6	0.026	4.30	1.89	8.20	8.64	3.11	6.82	0.55	2.74	209.	0.1140	19.50	19.2	12.36	4008	201	4008	201	4008			
Av. all	5.53	59.5	85.7	0.033	3.12	1.45	7.73	.....	2.73	9.36	0.54	3.39	171.8	0.0907	14.03	16.9	12.94	2857	172	2857	172	2857		
Com's	5.53	59.5	85.7	0.033	3.12	1.45	7.73	.....	2.73	9.36	0.54	3.39	171.8	0.0907	14.03	16.9	12.94	2857	172	2857	172	2857		

*Not included in averages.
 Prices of stocks are as of Feb., 1913.
 Figures in most cases based upon reports for 1911.
 Unquoted stocks are valued by capitalizing balance for dividends.

HYDRO-ELECTRIC POWER COMPANIES

Company	Gross Earnings			Per Dollar of Gross Earnings				Per Dollar of Net Earnings				Operating Ratio	Fixed Charges Times are Earned	Bonds Per				Population ,Per		Kilowatt Hrs. Mfd. Per
	Capita	Kilowatt Capacity	Consumer	Kilowatt Hour Manufactured	Bonds at Par	Pfd. Stock at Market	Com. Stock at Market	Capitalization as Shown	Bonds at Par	Pfd. Stock at Market	Com. Stock at Market			Capitalization as Shown	Capita		Consumer	Kilowatt Capacity		
															Capita	Consumer				
																			Capita		Consumer
EASTERN																				
51	2.37	28.7	4510	.....	5.57	1.72	2.09	9.38	12.2	3.70	4.52	20.42	0.53	1.66	581	.....	13.25	.....	12.10
52	4.72	28.9	4510	.....	8.82	.....	4.52	13.34	11.0	.....	6.15	17.15	0.19	1.40	254	.....	41.70	.....	6.09
53	1.83	11.6	.....	0.0026	11.09	.....	6.75	17.84	13.9	.....	10.20	24.10	0.20	1.36	128	.....	21.00	.....	6.15
54	0.92	8.8	.....	.....	14.88	.....	11.00	25.88	18.4	.....	13.60	32.00	0.19	1.09	130	.....	13.25	.....	9.50
55	4.34	21.3	.....	.....	7.28	.....	12.00	19.28	8.2	.....	13.55	21.76	0.11	2.70	598	.....	31.60	.....	4.85
Avg	.....	19.8	.....	0.0026	9.53	1.72	7.27	17.14	12.7	3.70	9.60	23.08	.....	1.64	680	0.026	24.16	950	7.74
SOUTHERN																				
56	6.32	15.2	209	0.0030	11.00	3.48	0.94	15.42	30.1	9.50	2.60	42.20	0.63	1.77	610	0.309	87.00	26	1.92	
57	6.31	14.4	.....	.....	3.96	9.32	2.37	15.65	6.2	14.50	3.71	24.40	0.36	4.00	374	.....	25.00	.....	2.27
58	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
59	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
60	.....	14.8	.....	0.0030	7.48	6.40	1.65	15.53	18.1	12.00	3.16	33.30	.....	2.88	492	0.309	56.00	26	2.09
Avg	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
WESTERN																				
61	1.87	14.2	9,430	0.0058	27.62	.....	3.31	30.93	48.5	.....	5.16	53.66	0.42	1.70	394	2580*	52.00	5025	7.60
62	12.95	28.9	102,800	0.0065	6.08	.....	10.75	16.83	7.5	.....	13.30	20.82	0.19	5.44	175	595	78.80	7930	2.22
63	1.61	28.9	457	0.0090	9.90	.....	2.12	12.02	16.3	.....	3.52	19.82	0.39	1.26	286	169	31.70	283	17.90
64	40.70	18.5	16	.....	10.30	.....	5.77	16.07	18.3	.....	10.40	28.65	0.45	1.39	188	481	41.40	3.82	0.45
65	13.20	50.5	.....	.....	6.67	0.57	0.19	7.33	15.0	1.28	0.44	16.72	0.55	1.63	333	85	85.40	3.85	.....
Avg	.....	28.2	.....	0.0066	12.11	0.57	4.43	16.63	21.1	1.28	6.56	27.93	.....	2.28	332	0.074	57.86	3310.45	6.40
NORTHERN																				
66	14.25	2.6	.....	.....	20.60	.....	0.57	21.17	34.5	.....	1.92	36.42	0.40	0.53	530	.....	29.4	.....	1.80
67	15.65	21.1	.....	.....	12.63	.....	2.64	15.27	16.0	.....	3.30	19.30	0.21	1.25	268	146	200	.....	1.35
68	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
69	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Avg	.....	.....	.....	.....	16.61	.....	1.60	18.22	25.2	.....	2.61	27.86	.....	0.89	399.0	146	24.7*	.....	1.57
MIDDLE WEST																				
71	1.18	13.1	.....	.....	12.47	2.88	4.90	20.25	16.6	4.53	12.10	33.23	0.25	1.20	163	840	14.65	.....	11.10
72	2.86	17.2	.....	.....	7.78	1.94	5.60	15.32	9.5	2.37	6.85	18.72	0.18	2.10	133	1170	22.25	.....	5.95
73	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
74	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Avg	.....	15.15	.....	.....	10.12	2.41	5.25	17.78	13.1	3.45	9.47	25.97	.....	1.65	1005	148	18.45	.....	8.52
Av. all Cos.	.....	20.2	.....	0.0112	11.04	3.32	4.72	16.99	17.6	5.98	6.95	26.85	.....	1.90	219	542	39.9	.....	5.94

*Not included in averages.
 *Miles of high tension transmission X K. W. capacity.
 Prices of stocks are as of Feb., 1913.
 Figures in most cases based upon reports for 1911.
 Unquoted stocks are valued by capitalizing balance for Dividends.

URBAN ELECTRIC RAILWAYS

Company	Gross Earnings Per			Bonds at Par	Pfd. Stock at Market	Com. Stock at Market	Per Dollar of Gross Earnings			Per Dollar of Net Earnings			Operating Ratio	Fixed Charges are Earned			Bonds Per		Car Miles Per		Passengers per Capita	Population per Mile of Track			
	Capita	Mile of Track	Passenger				Car Mile	Capital as Shown	Pfd. Stock at Market	Com. Stock at Market	Capital as Shown	Pfd. Stock at Market		Com. Stock at Market	Capital as Shown	Pfd. Stock at Market	Com. Stock at Market	Capital as Shown	Pfd. Stock at Market	Com. Stock at Market			Capital as Shown	Pfd. Stock at Market	Com. Stock at Market
EASTERN																									
76	6.80*	39,100*	0.032	2.49	.....	5.37	7.86	4.97	.....	10.65	15.72	0.50	3.23	\$99,000	\$0.947	\$16.90	44.2	0.145	212*	5750*			
77	12.50	17,700	0.041	3.31	.....	3.01	6.32	5.69	.....	5.13	10.82	0.41	2.66	38,600	1.660	41.90	67.0	0.145	304	925			
78	19.70	17,900	0.044	0.301	5.53	0.02	5.57	13.65	0.050	0.05	13.75	0.64	.....	99,000	0.947	110.00	67.0	0.145	455	905				
79	20.00	10,850	0.044	0.256	1.17	2.38	3.77	3.77	7.63	11.40	0.68	1.83	12,800	0.300	23.43	78.1	0.170	452	542						
80	14.40	19,100	0.035	6.65	0.003	0.47	7.12	12.30	0.005	0.87	12.77	0.45	1.25	132,000	1.900	95.41	51.4	0.127	405	1380					
Avg	16.65	14,863	0.039	3.83	0.015	2.25	6.08	8.08	0.03	4.87	12.77	0.54	2.24	76,280	1.20	57.53	60.2	0.147	404	938					
SOUTHERN																									
81	6.05	8,890	0.036	3.30	1.50	2.90	7.70	7.28	3.04	6.47	16.79	0.55	2.31	30,000	0.578	20.10	35.0	0.210	250	2940					
82	10.50	21,000	.....	0.440	0.92	1.99	4.96	5.12	2.34	5.03	12.47	0.60	2.13	43,200	0.895	21.50	24.0	.....	.....	2010		
83	9.83	13,100	.....	2.10	0.88	2.64	5.62	4.62	1.93	5.80	12.35	0.54	2.13	27,600	.....	20.50	56.5	0.152	.....	1325		
84	14.40	16,200	0.039	4.94	1.01	0.79	6.74	13.53	2.75	2.14	18.42	0.62	1.51	80,000	1.260	71.20	26.8	0.152	369	1120					
85	6.17	7,800	.....	2.20	.....	5.50	8.38	6.47	.....	12.30	18.77	0.55	3.35	22,500	0.665	17.78	26.8	0.152	.....	1260	
Avg	9.39	13,398	0.033	3.05	1.08	2.76	6.68	7.40	2.52	6.35	15.76	0.57	2.29	40,560	0.85	30.22	35.6	0.181	310	1731					
WESTERN																									
86	11.10	13,200	.....	1.61	.....	1.63	3.24	9.02	.....	9.15	18.17	0.82	2.20	21,200	.....	17.88	.....	.....	.....	1190
87	16.40	16,900	0.041	2.62	.....	2.67	5.29	5.33	.....	5.86	11.19	0.50	1.50	44,400	0.750	42.00	55.6	0.140	391	1050			
88	9.41	8,640	0.069	1.70	1.81	1.31	3.12	17.50	.....	7.70	25.20	0.84	1.86	15,600	0.320	17.05	53.1	0.390	124	915				
89	19.60	12,900	0.047	1.89	.....	4.46	6.35	4.50	.....	10.50	15.00	0.57	2.71	24,300	0.470	37.30	78.7	0.190	410	656			
90	18.80	30,000	0.035	5.23	1.31	0.11	6.65	13.00	3.23	0.29	16.52	0.59	1.05	157,000	1.880	99.20	52.8	0.090	540	1570					
Avg	15.10	16,328	0.048	2.65	1.31	2.03	4.93	9.87	3.23	6.70	17.22	0.66	1.86	52,500	0.86	42.69	60.1	0.203	364	1076					
NORTHERN																									
91	14.46	14,100	0.043	2.68	0.81	2.15	5.64	5.78	1.76	4.64	12.18	0.53	2.53	38,000	0.800	38.50	47.2	0.143	332	979					
92	6.65	8,450	0.032	0.190	2.05	3.46	5.51	6.64	.....	11.10	17.74	0.69	3.07	17,300	0.400	13.75	34.3	0.164	208	1270				
93	9.34	18,700	.....	0.190	0.59	3.85	4.44	1.41	.....	9.10	10.51	0.57	7.80	11,111	0.116	5.55	47.6	0.116	.....	2000		
94	13.10	24,300	0.029	2.80	1.11	.....	4.25	2.47	.....	6.90	9.37	0.54	2.00	27,200	0.330	14.70	44.1	0.097	453	1850			
95	14.80	20,000	0.038	2.335	2.49	0.55	5.74	5.00	1.10	5.40	11.50	0.50	2.63	50,000	0.830	37.04	44.1	0.113	392	1350					
Avg	11.70	17,110	0.036	1.78	0.68	3.06	5.12	4.26	1.43	7.43	12.26	0.57	3.61	28,722	0.49	21.91	43.5	0.129	346	1490					
MIDDLE WEST																									
96	39,400	0.024	0.300	2.35	2.52	4.87	8.10	8.64	16.74	0.71	2.65	93,000	0.700	11.50	0.098	2280				
97	11.40	26,000	0.024	1.57	.....	2.45	4.02	6.80	.....	10.50	17.30	0.76	1.62	41,000	0.260	18.00	49.5	0.107	462	.....				
98	13.50	18,300	.....	3.62	0.82	3.63	8.07	8.53	1.94	8.53	19.00	0.58	3.14	65,800	0.960	49.00	50.8	0.107	.....	.....			
99	18.10	23,000	0.036	4.88	.....	1.17	5.85	11.30	.....	2.82	14.12	0.58	2.21	107,000	1.190	85.00	71.0	0.140	510	1270			
100	15.90	26,000	0.034	4.97	0.56	0.21	5.75	15.00	1.71	0.63	17.34	0.66	1.45	129,000	1.470	79.40	54.0	0.116	464	1630					
Avg	14.72	26,540	0.029	3.44	0.69	2.00	5.71	9.95	1.83	6.22	16.90	0.66	2.21	87,160	0.92	48.58	56.3	0.115	479	1630					
Av. all	13.40	17,764	0.038	2.95	0.76	2.42	5.70	7.91	1.80	6.31	14.98	0.60	2.45	57,064	0.85	40.18	50.7	0.152	384	1337					

*Not included in averages.
 †Meaning gross passenger or freight earnings per mile.
 ‡Includes rentals capitalized at 5%.

Figures in most cases based upon reports for 1911.

"Bonds" include bonds and stock of subsidiary companies not owned.

Prices of stocks are as of Feb., 1913.

Unquoted stocks are valued by capitalizing balance for dividends.

INTERURBAN ELECTRIC RAILWAYS

Company	Gross Earnings Per			Per Dollar of Gross Earnings				Per Dollar of Net Earnings				Operating Ratio		Fixed Charges are Earned Times		Bonds Per		Car Mile		Capita		Passengers per Capita	Population per Mile of Track
	Capita	Mile of Track	Passenger	Car Mile	Bonds at Par	Pfd. Stock at Market	Com. Stock at Market	Capital as Shown	Bonds at Par	Pfd. Stock at Market	Com. Stock at Market	Capital as Shown	Operating Ratio	Fixed Charges are Earned Times	Mile of Track	Car Mile	Capita	Capita	Passenger				
EASTERN																							
101	\$1.43	5,730	\$0.18	\$0.34	\$7.91	\$0.21	\$0.07	\$8.19	17.85	0.48	0.16	18.49	0.56	0.90	\$45,800	\$2.70	\$11.40	4.15	0.54	7.0	4,020		
102	5.15	5,180	0.051*	0.26	7.25	.....	1.00	8.25	24.50	.....	3.30	27.80	0.70	1.14	37,800	1.96	38.20	19.50	0.19	105.0	993
103	0.21	8,350	0.10	0.28	6.45	.....	2.06	8.51	13.40	.....	4.28	17.68	0.55	1.30	53,800	1.86	1.36	0.73	0.37	2.0	39,600
104	0.37	5,300	0.27	0.31	7.18	.....	0.18	7.36	28.60	.....	0.71	29.31	0.74	0.40	38,100	2.27	2.71	1.19	0.85	1.4	14,050
105	1.92	3,955	0.17	0.34	7.30	0.07	0.08	7.45	13.70	0.30	0.13	13.99	0.49	1.10	28,900	2.50	14.05	5.62	0.51	10.9	2,060		
Avg	.....	5,703	0.18	0.31	7.22	0.14	0.68	7.95	19.61	0.13	1.72	21.45	0.61	0.97	40,880	2.26	.....	.....	0.49	.....	.....
SOUTHERN																							
106	2.55	1,721	.....	.....	4.27	.....	0.19	4.46	24.20	.....	1.58	25.78	0.82	0.80	7,350	.....	10.88	.....	.....	.....	675
107	13.30	8,892	.....	.....	6.92	.....	0.18	7.10	18.60	.....	0.50	19.10	0.62	0.90	61,580	.....	92.00	.....	.....	.....	666
108	9.65	15,420	0.06	0.40	3.45	2.15	2.93	8.53	7.16	4.47	6.07	17.70	0.51	2.60	53,400	0.14	33.40	24.10	0.15	1.6	1,600		
109	3.93	4,646	0.05	0.19	5.37	.....	0.06	5.43	14.70	.....	0.16	14.86	0.63	1.00	25,000	1.00	21.90	24.00	0.26	72.0	1,183
110	3.47	5,025	0.20	0.48	6.33	1.50	0.22	8.05	15.90	3.77	0.55	20.22	0.61	1.10	31,805	3.06	21.90	7.20	0.41	17.4	1,434		
Avg	.....	7,141	0.10	0.36	5.27	1.82	0.72	6.71	16.11	4.12	1.77	19.53	0.64	1.34	35,827	1.40	.....	.....	0.27	.....	.....
WESTERN																							
111	1.04	4,468	0.22	0.37	4.43	.....	0.02	4.45	20.60	.....	0.09	20.69	0.78	0.50	19,820	1.66	4.63	2.80	0.61	4.0	4,285
112	9.39	3,998	0.44	0.27	15.76	.....	0.15	16.21	50.00	.....	1.43	51.43	0.68	0.40	63,200	4.35	148.00	34.00	1.62	21.0	426
113	2.56	5,818	.....	.....	3.34	.....	3.24	6.58	8.55	.....	8.25	16.80	0.60	0.74	19,460	.....	8.56	.....	.....	.....	2,270
114	1.09	10,459	0.09	0.29	2.77	0.96	4.42	8.15	6.13	2.12	9.75	18.00	0.54	0.75	29,000	0.82	3.03	3.72	0.31	11.0	9,597		
115	14.56	6,738	0.26	0.28	2.98	1.15	0.60	4.73	10.42	4.05	2.11	16.58	0.71	0.75	20,000	1.67	43.40	19.20	0.34	20.2	462		
Avg	.....	6,296	0.25	0.30	5.86	1.05	1.15	8.02	19.14	3.08	4.33	24.70	0.66	1.43	30,296	2.12	.....	.....	0.87	.....	.....
NORTHERN																							
116	1.46	6,100	0.12	0.32	16.60	.....	0.27	16.87	50.20	.....	0.82	51.02	0.66	0.42	101,100	5.37	24.45	4.62	0.39	11.6	4,135
117	4.73	6,510	0.04	0.22	3.28	.....	2.29	5.57	10.45	.....	7.29	17.74	0.68	1.70	21,410	0.74	15.54	21.00	0.20	104.0	1,378
118	7.87	9,360	0.05	0.36	3.76	0.63	1.75	6.14	7.90	1.28	3.65	12.83	0.52	1.70	35,350	1.38	29.60	21.40	0.13	165.0	1,190		
119	0.73	4,665	0.13	0.28	5.03	3.35	0.46	8.94	17.90	7.87	1.08	20.75	0.57	2.10	23,410	1.41	3.70	2.62	0.48	5.4	6,325		
120	6.10	2,822	0.26	0.32	6.63	.....	0.35	6.98	17.90	.....	0.96	18.85	0.63	1.05	18,750	0.46	40.50	1.87	0.80	23.2	463
Avg	.....	5,891	0.12	0.30	7.06	1.99	1.02	8.88	19.65	4.57	2.76	24.24	0.61	1.40	40,004	1.87	.....	.....	0.40	.....	.....
MIDDLE WEST																							
121	0.78	13,000	0.13	0.32	4.38	1.50	0.70	6.58	10.38	3.65	1.72	15.75	0.59	1.70	57,200	1.42	3.45	2.44	0.42	5.8	16,500		
122	4.72	3,350	0.21	0.32	10.35	0.10	0.09	10.54	41.80	0.43	0.40	42.63	0.75	0.50	34,700	6.40	48.90	7.65	0.70	11.4	712		
123	0.57	6,270	0.14	0.32	7.40	.....	0.05	7.44	16.22	.....	0.01	16.23	0.54	1.05	46,400	2.38	4.25	1.77	0.43	4.1	10,930
124	3.28	8,075	0.12	0.38	3.75	.....	5.92	9.67	6.98	.....	11.05	18.03	0.46	2.40	30,600	1.42	12.30	8.60	0.33	25.9	2,480
125	2.05	3,950	.....	.....	8.35	.....	0.38	8.73	37.50	.....	1.73	39.23	0.77	0.50	32,350	2.37	17.10	7.23	.....	.....	1,925
Avg	.....	6,929	0.15	0.32	6.85	0.80	1.43	8.59	22.57	2.04	2.98	36.37	0.62	1.23	40,250	2.75	.....	.....	0.47	.....	.....
Avg. all Cos.	.....	6,392	0.16	0.31	5.64	1.16	1.11	8.03	19.22	2.82	2.71	23.26	0.62	1.27	37,451	2.15	.....	.....	0.50	.....	.....

*Not included in averages.

†Meaning gross passenger or freight earnings per mile.

‡Includes rentals capitalized at 5%.

Figures in most cases based upon reports for 1911.

Figures for steam railways based upon reports for year ending June 30, 1912.

Bonds include bonds and stock of subsidiary companies not owned.

Prices of stocks are as of Feb., 1913.

Unquoted stocks are valued by capitalizing balance for dividends.

STEAM RAILWAYS

Company	Gross Earnings Per			Per Dollar of Gross Earnings			Per Dollar of Net Earnings			Operating Ratio	Times Fixed Charges are Earned	Passenger Miles per Passenger	Freight Miles per Ton	Average Freight Train Load Tons	Mile of Road		Tons Revenue Freight									
	Mile of Road	†Passenger Mile	†Ton Mile	†Bonds at Par	Pfd. Stock at Market	Com. Stock at Market	Capitalization as Shown	†Bonds at Par	Pfd. Stock at Market						Com. Stock at Market	Capitalization as Shown		Operating Ratio	Times Fixed Charges are Earned	Passenger Miles per Passenger	Freight Miles per Ton	Average Freight Train Load Tons	Mile of Road		Passenger	Tons Revenue Freight
																							†Bonds Per	Train Mile		
EASTERN																										
Bu. Ro. & P.	16,711	0.0207	0.0443	2.67	4.05	0.72	1.10	5.84	12.60	2.24	3.41	18.25	0.680	1.84	26.30	159.3	647	\$57,518	\$ 9.82	3,420	18,800					
Erie R. R.	23,785	0.0157	0.0353	2.33	4.62	0.48	0.57	5.67	16.50	1.76	2.04	20.30	0.700	1.19	23.30	184.6	527	115,700	11.35	11,620	16,350					
Leh. Valley	25,333	0.0177	0.0365	2.73	3.19	0.01	4.20	8.10	19.95	0.02	15.27	25.24	0.670	1.86	49.60	170.8	566	82,300	8.93	3,710	19,450					
NY, NH & H	31,049	0.0172	0.0137	1.87	5.63	.....	7.93	8.42	16.01	.....	7.93	23.94	0.618	1.63	18.40	94.9	291	174,500	15.00	40,400	11,830			
Pa. R. R.	40,621	0.0198	0.0059	2.77	3.22	.....	5.92	8.12	.....	21.57	23.67	0.725	2.36	25.58	155.1	671	96,500	6.84	16,500	30,600				
Average	27,516	0.0182	0.0073	2.48	3.94	0.40	3.06	7.24	12.63	1.34	10.04	23.48	0.685	1.78	28.6	152.9	540	105,304	10.38	15,130	19,406					
SOUTHERN																										
Louis. & N.	11,935	0.0229	0.0078	2.24	2.55	.....	1.43	3.98	8.65	1.02	4.85	13.50	0.705	2.01	43.25	170.0	285	30,500	5.11	2,610	6,475				
M. K. & T.	8,294	0.0235	0.0108	1.98	5.04	0.25	0.51	5.80	20.40	.....	2.04	23.46	0.752	1.00	61.34	240.0	197	41,900	10.14	1,675	2,580				
N. C. & St. L.	9,969	0.0233	0.0103	1.81	2.31	.....	1.30	3.61	9.84	.....	5.95	15.39	0.764	1.75	40.00	146.0	192	23,100	4.20	2,545	4,580			
St. L. & S. W.	7,778	0.0262	0.0107	2.46	5.11	1.12	0.34	6.57	16.98	3.73	1.15	21.86	0.699	1.56	36.84	245.0	292	39,700	12.53	1,538	2,201					
Southern	8,971	0.0215	0.0098	1.89	5.15	0.73	0.44	6.32	16.40	2.36	1.42	20.18	0.687	1.40	43.41	154.0	250	45,700	9.62	2,558	3,840					
Average	9,339	0.0235	0.0099	2.08	4.03	0.70	0.80	5.26	14.45	2.37	3.00	18.88	0.721	1.54	44.9	191.0	243	36,180	8.32	2,185	3,935					
WESTERN																										
A. T. & S. F.	10,039	0.0215	0.0103	2.32	3.32	1.02	1.57	5.91	9.83	3.05	4.62	17.50	0.661	2.01	90.74	329.0	400	32,200	7.05	1,322	1,990					
Col. & So.	7,420	0.0252	0.0093	2.18	4.62	0.76	0.65	6.03	14.85	2.36	2.11	19.32	0.688	1.41	40.50	148.0	314	34,270	10.10	1,690	3,790					
C. M. & St. P.	8,403	0.0204	0.0083	2.00	3.75	2.47	1.93	8.15	15.35	10.17	7.93	33.45	0.756	1.75	48.24	192.0	287	31,600	7.44	1,889	3,540					
D. & R. G.	9,126	0.0193	0.0121	2.54	5.33	0.67	0.32	6.32	19.80	2.50	1.20	23.50	0.729	1.16	143.00	116.0	264	48,800	13.60	1,994	4,300					
Un. Pac.	11,773	0.0219	0.0098	2.89	4.07	0.99	3.70	8.76	9.62	3.35	8.75	20.72	0.872	2.66	103.00	381.0	424	48,706	11.58	1,290	2,096					
Average	9,352	0.0217	0.0099	2.39	4.22	1.18	1.63	7.03	13.89	4.09	4.92	22.89	0.682	1.79	85.1	233.2	338	39,115	9.95	1,563	3,249					
NORTHERN																										
Can. Nor.	5,365	0.0211	0.0076	2.12	6.47	.....	0.33	6.80	22.20	.....	1.15	23.35	0.708	1.07	94.20	335.0	311	34,600	13.60	434	1,540			
Can. Pac.	11,453	0.0194	0.0077	2.67	1.92	0.51	3.43	5.86	5.10	1.46	9.80	16.36	0.649	4.21	118.40	379.0	372	21,100	5.05	1,278	2,010					
Gt. Nor.	8,983	0.0248	0.0077	3.00	2.41	.....	3.96	6.37	5.53	.....	9.20	14.73	0.569	3.02	67.07	226.0	601	21,540	7.25	1,108	3,736			
Grand Tk.	10,925	0.0236	0.0069	1.86	4.36	2.58	0.68	7.62	15.80	9.32	2.46	27.58	0.723	1.56	.....	181.0	317	47,600	8.13	3,480	5,840				
Nor. Pac.	10,526	0.0236	0.0086	2.95	3.08	.....	4.08	7.16	7.53	.....	10.25	17.78	0.601	2.80	75.00	289.0	515	31,700	8.95	1,498	2,890			
Average	9,450	0.0222	0.0077	2.12	3.65	1.54	2.49	6.76	11.23	5.39	6.57	19.96	0.650	2.53	88.7	282.0	423	31,308	8.59	1,547	3,223					
MIDDLE WEST																										
Chi. & Al.	14,171	0.0195	0.0057	2.03	5.61	0.23	0.13	5.97	22.20	0.93	0.50	23.63	0.748	0.92	55.00	159.7	203	79,300	11.29	3,720	989					
C. & N. W.	9,377	0.0181	0.0091	1.92	2.65	0.52	2.34	5.51	5.31	1.85	8.22	19.38	0.715	1.91	34.30	138.1	299	24,900	5.08	4,020	4,740					
Burlington	8,557	0.0191	0.0075	2.48	4.42	.....	2.62	5.04	8.06	.....	8.71	16.77	0.699	2.02	49.40	255.0	438	23,130	6.02	2,360	3,320			
C. R. I. & P.	8,053	0.0198	0.0089	1.85	4.34	.....	0.87	5.20	15.70	.....	3.15	18.85	0.722	1.26	49.60	242.4	278	35,100	8.07	2,470	2,361			
Wabash	11,276	0.0188	0.0058	1.69	4.44	0.10	0.05	4.58	24.20	0.54	0.25	24.99	0.816	0.83	60.00	231.7	353	50,400	7.84	2,025	5,370					
Average all	10,487	0.0191	0.0074	1.98	3.89	0.23	1.00	5.28	15.89	1.11	4.17	20.72	0.740	1.39	49.7	205.4	314	42,566	7.66	2,919	3,556					
Average companies	13,239	0.0209	0.0084	2.29	3.94	0.82	1.83	6.31	13.62	2.85	5.74	21.18	0.695	1.81	58.2	212.9	372	50,894	8.98	4,678	6,334					

*Not included in averages.
†Meaning gross passenger or freight earnings per mile.
‡Including rentals capitalized at 5%.
Figures in most cases based upon reports for 1911.

Figures for steam railways based upon reports for year ending June 30, 1912.
"Bonds" include bonds and stock of subsidiary companies not owned.
Prices of stocks as of Aug., 1913, for steam railways.
Unquoted stocks are valued by capitalizing balance for dividends.

The size of the community must be considered as the statistics used are those of companies operating in towns of more than 50,000 population. The units bring out features of capitalization, the extent of the development of the business in the territory, sufficiency of rates, whether the company is over built, etc. The figures were rather difficult to obtain for the reason that it is hard to get statistics on companies which operate purely gas or electric light service. Usually public service companies supply more than one class of service. Once having obtained these

Unit Analysis.

	Company Under Investigation	Average Four Middle- West Cos.	Average Twenty- Five Gas Cos.
Gross Earn. per Capita.....	\$ 6.32	\$ 5.83	\$ 4.27
" " per Mile of Main.....	5,025.00	4,018.00	3,167.00
" " per Customer	31.80	29.08	29.84
" " per M cu. ft. gas mfg....	.83	.89	1.01
Operating Ratio	*48%	62%	60%
Bonds @ par per \$ of gross.....	4.60	3.41	3.80
Pfd. @ mkt. per \$ of gross.....	.56	—	1.17
Com. @ mkt. per \$ of gross.....	2.54	2.44	2.47
Capitalization (as shown) per \$ gross	7.70	5.99	7.35
Bonds @ par per \$ of net.....	9.06	9.12	9.36
Pfd. @ mkt. per \$ of net.....	1.13	—	2.63
Com. @ mkt. per \$ of net.....	4.85	6.37	8.20
Capitalization (as shown) per \$ net	15.04	15.77	17.61
Times Fixed Charges Earned.....	3.5	2.58	2.5
Bonds per mile of main.....	23,180.00	9,792.00	8,772.00
Bonds per M cu. ft. of gas.....	3.83	2.34	3.33
Bonds per capita	29.62	14.54	13.55
Population per customer	5	6.1	8.06
" per mile of main.....	795	735	772
M cu. ft. of gas sold per consumer	38.4	30	29.7
M cu. ft. of gas sold per capita....	7.6	5.05	4.45

*Does not include depreciation.

figures, however, it is easy to measure the statistics of a company operating more than one service by taking the unit figures for gas companies and electric companies and combining them as will be explained in a later illustration.

An example of the application of these figures is shown in above tabulation, where we have taken a gas company and compared it with our unit figures in the tables. From the fourth unit it appears that the company obtains a lower average rate than is customary. Nevertheless their earnings as are shown by

the first three units are higher than those of the average middle west companies. This must mean that the company sells each consumer more than the average amount of gas. This is brought out in the last two units. The capitalization figures bring out interesting facts.

We use the market value of the stocks rather than the par value as indicating nearer the true capital represented in the company. The bonds are taken at the par value for the reason that they are a par obligation.

In this particular case, the amount of bonds outstanding at par per one dollar of gross earnings is larger than is the usual case. We deduce from this the fact that the bonds should not have as high a credit rating as those of a company having indebtedness more nearly the average. The figures for net earnings do not carry much significance due to the fact that corporations have different methods of reporting their net earnings, some including in their operating expenses and taxes their maintenance charges both for current repairs and accruing depreciation, while others include in operating expenses only repairs up to a certain established amount, the balance being charged to their depreciation reserve, and not showing the deductions from the gross earnings to get the net. The figures in this case further indicate that the company has a high average of consumers out of the total population and that the consumers are fairly well concentrated along the mains.

The next table presents a hypothetical statement of a corporation supplying gas and street railway service. It is assumed that the segregated earnings of the two departments are not available and the only thing that can be done is to check up the total gross earnings to see if this would measure up to what might be expected. This is done by taking the various units of service such as car miles, passengers carried, etc., and multiplying these figures by the unit figures from the tables.

Railway and Gas Company Statistics.

Capital Stock	\$2,000,000	
Bonds	6,500,000	
Gross Earnings		\$2,300,000
Operating Expenses & Taxes.....		1,500,000=65%

Net Earnings\$ 800,000

Population	125,000
Miles of Track.....	100
Car Miles Operated (Year).....	5,880,000
Passengers Carried (Year).....	40,000,000

Miles of Mains	170
Consumers	20,700
1,000 's Cu. Ft. Gas Mfg.....	455,000

TO CHECK GROSS EARNINGS.**Gross Earnings Railway Department.**

Statistics of Company.		From Unit Tables.	Average Gross Earnings.
125,000 Pop.	x	13.40 gross per capita	\$1,675,000
100 Mi. track	x	17,764.00 gross per mi. track	1,776,400
40,000,000 Passengers	x	0.038 gross per passenger	1,520,000
5,880,000 Car Miles	x	0.269 gross per car mile	1,581,720
Average			\$1,638,280

Gross Earnings Gas Department.

125,000 Pop.	x	4.28 gross per capita	\$533,750
170 Mi. main	x	3,167.00 gross per mi. main	538,390
20,700 Consumers	x	29.84 gross per consumer	617,688
455,000 M Cu. Ft. Gas	x	1.01 gross per M. cu. ft. gas	459,550
Average			\$537,344

Gross earnings for Railway Department should be.....	\$1,638,280
Gross earnings for Gas Department should be.....	537,344

Total	\$2,175,624
Actual	2,300,000

Estimated Fair Bonded Debt for Railway Department.

Statistics of Company.		From Unit Tables	Average Fair Bonded Debt.
		Bonds per	
100 Mi. track	x	57,064.00 mi. track	\$5,706,400
5,880,000 Car miles	x	.85 car mile	4,998,000
125,000 Population	x	40.18 capita	5,022,500
Average			\$5,242,300

170 Mi. main	x	8,771.90 mi. main	\$1,491,223
455,000 M cu. ft. Gas Mfg.	x	3.33 M cu. ft. gas mfg.	1,515,150
125,000 Population	x	13.55 capita	1,693,750

Average \$1,566,707

FAIR BONDED DEBT RAILWAY DEPARTMENT	\$5,242,300
FAIR BONDED DEBT GAS DEPARTMENT	1,566,707

TOTAL	\$6,809,007
ACTUAL	6,500,000

We can then estimate what the gross earnings should be for the railway department and likewise for the gas department. Adding these together would give the estimated expected gross earnings from a corporation of this size. This can then be compared with the stated gross earnings to measure up their sufficiency. The other figures show a method of roughly estimating whether the indebtedness of the company is excessive or equal to what might be expected from the average. These figures are obtained in a manner corresponding to those by which the gross earnings were compared.

Other units can be obtained from the statement given to measure up the adequacy of the earnings, etc. Statistics are not entirely reliable and it is not claimed that with the use of these figures one can state whether a security has the value which it is reported to have or not. However, the figures do bring out certain vital factors and are an aid in a rapid analysis of a corporation.

The following table is a study of railroad reorganizations in abbreviated form and is self explanatory and is merely presented to show the work which is done by some investment bankers in assisting their clients in the proper course to pursue when receivership overtakes a company in which they hold securities.

Railroad HISTORY		Union Pacific	Atchison	Reading	Balt. & Ohio	**Erie	Northern Pacific
Receiver appointed		Oct. 1893	Dec. 1893	Feb. 1893	Feb. 1896	July 1893	Aug. 1893
Property sold at foreclosure sale		Nov. 1897	Dec. 1895	May 1896	July 1899	Nov. 1895	July 1896
EARNINGS							
Net Earnings before receivership		\$ 7,553,468	\$ 12,568,000	\$ 11,199,042	\$ 8,469,000	\$ 9,845,382	\$ 12,924,000 ^x
Fixed Charges before receivership		7,985,925	9,423,160	8,041,000	6,759,000	9,971,853	13,813,945 ^x
Net Earnings after reorganization		9,618,208 ^a	6,898,942 ^b	10,104,000	7,724,758	7,724,084 ^c	6,724,766 ^a
Fixed Charges after reorganization		3,830,000 ^a	6,473,230 ^b	10,600,000	6,359,896	6,932,208 ^c	6,146,961 ^a
CAPITALIZATION							
Bonds before receivership		\$85,492,185	\$233,595,247	\$148,900,000	\$ 80,423,000	\$174,478,000	\$128,732,000
Bonds after reorganization		90,000,000	148,718,892	114,000,000	120,000,000	137,704,100	156,157,500
Preferred Stock before receivership		52,000,000 [†]	NONE	NONE	5,000,000	18,536,600	36,564,250
Preferred Stock after reorganization		75,000,000	111,486,000	70,000,000	35,000,000	46,000,000	70,000,000
Common Stock before receivership		60,868,500	102,000,000	39,830,000	25,000,000	112,836,350	49,000,000
Common Stock after reorganization		61,000,000	102,000,000	70,000,000	35,000,000	100,000,000	80,000,000
Bonds before receivership—per cent.		43.1	69.2	78.9	75.5	57.2	60.0
Bonds after reorganization—per cent.		39.8	41.0	45.0	63.2	48.6	51.0
Preferred Stock before receivership—per cent.		26.2 [†]	0.0	0.0	4.1	6.0	17.1
Preferred Stock after reorganization—per cent.		33.2	30.8	27.5	18.4	16.2	22.9
Common Stock before receivership—per cent.		30.7	30.8	21.1	20.4	36.8	22.9
Common Stock after reorganization—per cent.		27.0	28.2	27.5	18.4	39.5	26.1
ASSESSMENTS							
First Preferred Stock				*20%	\$ 2.00	¢ 8.00	\$ 10.00
Second Preferred Stock					20.00		
Common Stock		\$ 15.00	\$ 10.00	\$ 20.00	20.00	12.00	15.00
Second Mortgage Income Bonds			4%	4%			
PRICE OF COMMON STOCK							
One month before receivership		21½	19¼	52½	43	17½	11
One month after receivership		17¼	11½	22½	18¼	11½	7½
One month after reorganization plan announced		10½	5%	2½	12¾	8½	1½
One month after payment of assessment		25¾	20%	31¾	44¾	15	11½
Six months after reorganization		20.00	13%	22½	56¾	14½	13¼
January 3rd, 1913		161½	106½	168½	114	32¼	121¾

NOTE.—*Preferred Bonds; †Government Debt.
 sinking fund payments, and taxes in some cases. xIncluding Wisconsin Central. aTen months earnings multiplied by 1.2.
 bSix months earnings multiplied by 2. cSeven months earnings multiplied by 1.714.

AUTHORITIES—Poor's Manual; Railroad Reorganization, Stuart Daggett; Commercial and Financial Chronicle.

Selling Investment Bonds.

It has been said that a bond well bought is half sold. This is probably not overstating the case. However, the selling of securities is a very great problem. It calls for constant thought and work. The field for bond investment is unlimited.

The selling department deals with blanks, insurance companies and individuals as well as trading in the market with other dealers.

The matter of syndicates is a very interesting question and I wish to say just a few words along the line of this branch of the work. The underwriter of a large bond issue will purchase the entire issue at a certain price. He will then form a syndicate, which means, that a group of investment bankers over the country will subscribe to a participation in the purchase of the security.

In order to present the case clearly, we will say that J. P. Morgan and Company will buy an issue of railroad bonds totaling \$10,000,000 at a price of 95 per cent of the par value. They will then form a syndicate and put the bonds into the syndicate usually stating what their individual profit is in the sale to the syndicate.

Various investment bankers will then be given an opportunity to participate in the syndicate and their ratio of the profits (or losses) of the syndicate will be according to the amount of the bonds for which they subscribe. For instance the bonds will be put into the syndicate at $95\frac{1}{2}$ and selling price fixed at $98\frac{1}{2}$ per cent with certain discounts to other dealers and a selling commission allowed to the participants in the syndicate.

As soon as all the bonds are sold the syndicate is closed and the profits are distributed to the subscribers, or the losses are assessed, according to whether the syndicate has been a success or not. All of the subscribers sell as many of the bonds as possible not limiting themselves to the amount of their subscription. Oftentimes in unsuccessful syndicates the syndicate is closed and the various subscribers then have to assume their proportion of the unsold bonds.

Other times bonds are sold so rapidly that some subscribers to the syndicate do not have an opportunity to sell a bond. This means, of course, that other participants have sold a great many more than their participation.

There are variations of syndicates. One is the undivided

joint account syndicate. Here every subscriber makes himself liable for a certain amount of the syndicate and remains liable for his pro rata amount until every bond in the syndicate is sold.

The divided joint account is really not a syndicate. In this case, the participants have delivered to them the amount of bonds allotted to them at the syndicate price and their liability is confined to this amount of bonds only and when they have sold these bonds their liability ceases. The only reason this could be called a syndicate is that the participants are sometimes restricted as to territory and also as to price. Investment syndicates are simply an association of investment bankers formed for the purpose of marketing large blocks of bonds.

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

REPORT ON WINTER UNEMPLOYMENT

By J. P. NEWELL, E. G. HOPSON, ET AL.,
A SPECIAL COMMITTEE OF THE OREGON SOCIETY OF ENGINEERS.

To the Members of the Oregon Society of Engineers:

We have the honor to submit the following:

The question of unemployment in the winter months due to the general cessation of engineering work is a serious one, more especially during periods of general business depression, such as the present. While it is an admitted fact that a large proportion of engineering activities cannot be advantageously carried out during the winter, the extent of economic and practical disadvantages of winter as compared with summer operation is believed to be to a very considerable extent overestimated in the Northwest.

Climatic conditions are the principal, if not the only, causes that militate against winter work in engineering operations. In most of the northern and eastern sections of the country, winter cold unmistakably puts the greater part of engineering work out of the question, or makes it so precarious and expensive as to be practically impossible. These reasons do not, however, fully apply to the Pacific Coast, where the modifying effect of the Pacific Ocean on temperature is very marked.

We are all to a very large extent creatures of habit and a large percentage of us have grown up under conditions where it has been necessary to shut down work during much of the year. The hardship of this seasonal closing of out-door work does not need to be emphasized. It presses not only on the mass of unskilled labor but on the engineers of this society. If by some systematic organization and endeavor something can be done to increase the winter output of engineering work by taking full advantage of our peculiar geographic and climatic conditions, it will be of almost inestimable advantage to the community.

In September, 1914, the Oregon Committee on Seasonal Employment, organized at the request of the American Association for Labor Legislation, made a report through Dr. Frank O'Hara, Associate Professor of Economics, Catholic University of America, Washington, D. C. This deals with a number of industries other than the engineering industries, and contains a number of special reports by various public officials, heads of

departments, business men, engineers and others, dealing with the matter of employment. Various recommendations are made in this report which are worthy of attention in the consideration of the question from the standpoint of engineering activities, which, after all, are only one branch of the activities in the State.

Professor O'Hara's report deals with the employment question from the standpoint of the interest of the laborer, and the effect upon the community of causes operating to his injury. The employer is almost equally interested with the laborer in the improvement of winter conditions. He is also able to do something to improve these conditions, while the unemployed laborer is helpless. As already stated, the cessation of outdoor work at the approach of the winter season is largely the result of habit. Much work could be carried on during the winter if proper preparations were made and precautions taken. There would necessarily be some interruptions, but stoppage of work during storms usually works little hardships either to employer or laborer. In some cases a slight reduction in wages might be necessary to offset the cost of protecting work from injury by the weather. But there are other factors than the reduction of wages which tend to balance such additional expense. In winter the cost of obtaining labor is reduced to a negligible quantity, and its efficiency is much increased by the desire of the laborer to hold his job. The increased percentage of time during which construction plant can be kept busy reduces interest and maintenance charges.

A detailed consideration follows of various engineering activities, all prepared by or based on the statements of men qualified by experience and training to speak with authority on the subjects discussed.

So far as these statements refer to private activities, we can hope to change conditions only by the dissemination of information or by appeal to public spirit, but a very considerable proportion of engineering work is public work performed directly by the government, the state, the county, or the municipality. The same public agencies that control so large a share of engineering activities also have direction of the public institutions for taking care of paupers and furnishing relief, and also are responsible for the raising of revenue for all purposes.

It is believed that a very important advantage can be secured by an insistent endeavor on the part of all agencies directing engineering work of a public character to give winter operation

the preference whenever conditions permit of a choice, by systematically deferring summer work wherever it is possible so to do without sacrificing other interests of preponderating importance.

It is believed that all agencies carrying out engineering work whether public or private, should act in line with the above principle, but it is peculiarly the duty of the governmental agencies directing public works as well as public taxation and relief of the poor, to see to it that this principle is enforced in public work, as a measure of relief to the taxpayer, who has to foot the bills not only for the engineering work but for the relief of the poor and destitute.

At various times there has been advanced the argument that winter work should not be carried on when an analysis of cost shows that the work cannot be as economically performed during the winter season as in the summer. This argument, while intended to be founded on the true laws of economics, is frequently used in a very narrow sense. If a difference of a few cents per yard in the cost of work as taken from a cost account sheet indicates that winter work of a certain character is apparently a little more costly than summer operations of a similar kind, it does not necessarily follow that the difference in cost is an economic waste or should not be incurred. If the cessation of operations during the winter months means that large bodies of men will be thrown out of work and possibly become a public charge, the economy of stopping the work in order to take advantage of the apparent economy in yardage cost does not appear evident as viewed from the standpoint of the public. These are matters which require very careful consideration, and certainly if an error is made in reaching a decision the error should lie in the direction of keeping as large a body of citizens employed on useful work as is possible.

It is believed that the adoption of the principle above referred to by public agencies would in time lead to similar action by private agencies, and that by this means a considerable measure of relief may be brought about.

Remedies.

State: It is suggested that formal action be taken, possibly by the appointment by the Governor of a commission of engineers to supervise all State engineering operations in the interests of winter employment. This commission should be of a non-partisan

character, to consist of not more than three engineers to act without salary or other compensation than travel expenses and actual expense incurred for office rent, stationery or clerical assistance.

All State operations of an engineering character involving the employment of labor, excepting purely professional engineering work, should be carried out only after such a commission has certified that in its judgment full consideration has been given to the interests of winter employment of labor in the disposition and arrangements of said work. When directed by this board to undertake work during the winter, the engineers in charge would be relieved from responsibility for additional cost resulting from such action.

Municipal: As pointed out by Mr. Keyser, Park Engineer of Portland, municipal fiscal arrangements have much to do with the present congestion of work in the summer time. All public work is planned to begin in the spring or early summer. Budgets are made up in the late fall or winter. Taxes are collected in the spring, and no work can be started until the money is in hand to pay for it. The result is that our public works departments everywhere are competing in the labor market for the men who should be engaged in the fields or forests. The activities which are fundamental to our industrial system are thus hampered instead of helped by administrative action.

Much can be done to remedy this condition by a simple change of policy. Work which is paid for out of the public funds should be carefully studied, and every part of it, the cost of which will not be unreasonably increased, should be put off until winter. Frequently a part can be thus deferred by doing some other part during the good weather. Contracts for work which is paid for by assessments on property benefited should be let about the last of the year, the same date for completion being given as though let in the spring. Contractors will then take advantage of the abundance of labor in the winter to perform all work possible in that season, and the result will be a reduction instead of an increase in cost to the property owner.

Private: The most important factor in the amelioration of conditions of winter unemployment is to be found in the general recognition of the fact that we are neglecting much of the advantage to be derived from our mild climate; that we can extend our industrial year, and that in doing so we shall reduce the excessive competition for labor in the summer, and the resulting

high cost of industrial operations. We must reduce the influx of laborers during the busy season, and consequent over-supply in the winter, so that the remainder will be able to support themselves by honest labor instead of appealing to charity.

House Building.*

It is undoubtedly true that certain owners contemplating building avoid starting the work in the winter. This is evidenced by the increased amount of work in architects' offices during the early spring as compared to the volume of work during the winter, and the large amount of estimates made, and contracts let during the spring. The reasons for this are not clear, but undoubtedly one reason is the belief that work cannot be carried on to advantage in the winter.

Experience has shown that ordinary building operations can be carried on during the winter successfully, and to the advantage of both the owner and builder. The work may be subject to interruptions, such as stopping of concrete work, plastering, and masonry to avoid danger of freezing in the cold spells; but these interruptions are of short duration. Special care should also be exercised in foundation work to avoid danger of slides, soft bottoms, etc. Aside from such minor interruptions and extra precautions, the work can continue as usual.

Undoubtedly the costs of certain items in a building operation are increased in the winter due to the weather conditions, but experience shows that this extra cost is neglected by the majority of contractors in estimating their work, due to a desire to keep busy and maintain their organizations intact. In fact, we are informed by some builders, that due to a scarcity of work in the winter, their practice is to figure a little closer, in order to secure work.

In the erection of the Meier and Frank store, a steel frame, 12-story building built during the past winter, erectors have lost but four days on account of the weather, and the other trades have worked continuously.

Park Construction and Maintenance.†

In the construction of Hillside Parkway, Portland, a contract was signed on July 26, 1912, for some 140,000 yards of excavation. About 45,000 yards of earth was sublet to a contractor

*By Committee of Oregon Chapter, American Institute of Architects, W. G. Holford, Chairman.

†By C. P. Keyser, Engineer, Bureau of Parks, Portland, Oregon.

who told me that he took the work for a winter job to feed his stock and hold his organization together, and that he broke even at twenty-two cents per yard, which was a low figure even for summer work. He worked between storms and so managed as always to have some dry dirt available. In the spring he finished, taking about ten days of favorable weather. It is my understanding that he did not cut the rate of pay, but of course was free to pick his men. Also there were weeks when the men hardly earned enough to pay their board.

The rock work, 95,000 yards, was sublet to another contractor who handled it by station work, mostly tunnel and trap method, and prosecuted it regardless of the weather. This contractor did not make any great profit but the main reason was that he took the work too cheap, and besides it took him sixteen months to execute what he figured on doing in 150 days.

Another contract by the Park Board covered the construction of a concrete swimming pool, a \$4,000 job. Everybody's intentions were good to build the pool in the early fall, but it was actually built in December and January, with temperature several degrees below freezing and incidentally, a light fall of snow, in addition to the usual rain. There were three first-class cement finishers on the job, working at \$2.50 per day, because they needed work and the contractor expected to need finishers again.

In point of structural excellence, I have never been connected with a better piece of concrete work. The contractor told me that his books showed a small profit, although he took the work at \$400 less than my estimate of cost, which I had figured close. He had all of his forces otherwise engaged during the time in which he should have been doing this work, and when he reduced his forces, put only picked men on the swimming pool. With the exception of the inside mortar facing which had to be put on with regard to the weather, and in some places put on three times before it passed inspection, I doubt if the work cost any more than if done in favorable weather with unfavorable or indifferent help. I should say 5 per cent would amply cover any expense occasioned by reason of adverse weather conditions.

The above work was done under a bond issue, with the money available at any time. Most of our work must needs be done by tax levy, which requires a budget. This is made up in the late fall to cover our fiscal year, beginning December 1st. Tax money does not come in until March and under our system it is not feas-

ible to carry much over the winter. It occurs to me that if the fiscal year could be advanced to July 1st, the Commissioners could let contracts or authorize work in the early fall instead of in the spring. This would enable contractors to take advantage of the abundant supply of labor in the winter months.

In our Department we have laid off no men this winter, except "for the good of the service." In the spring we shall probably put a few more men to work, and in the fall weed out again as thoroughly as we can. From my observations covering a period of six years in park work, I am of the opinion that we get as much work out of our labor in winter as in summer, and of course we have a flat wage.

Some kinds of construction cannot be executed economically in wet weather, but I believe we are in the habit of listing too many jobs under this classification. Hard-surface paving is a notably dry weather job, but I remember that Belmont Street, between East 50th and 60th Streets was paved with a bituminous pavement in very unfavorable weather, and I question if an expert could at any time since, designate which portions of Belmont Street were paved in favorable and which in unfavorable weather.

In conclusion, I should say: (1) That taking such park construction work as can be done without intermission, ten per cent will cover damage by, and protection from, storms and freezing, and that five per cent would be a nearer average safe figure if the probable weather were properly and legitimately considered in advance; (2) That if construction work were properly organized and operated, that there would be no occasion to reduce the hourly rate of pay of the laborers who would "stick" and have steady employment, if not at full time, during the winter; (3) That there is a large proportion of construction work which could be done out of season, if labor were willing to work for a diminished rate to offset a more expensive method of operation, and more time were allowed for the execution of the work; that a twenty per cent reduction ordinarily would be the maximum that out-of-season work would justify, where it would begin to border on charity; (4) That the element of time in our contracts has altogether too important an effect on the price bid; by eliminating the unnecessary hurry we can reduce the unit prices. If we can give a contractor a chance to carry his work along during the winter instead of finishing it up in the fall, or give him a year

and a half instead of a half year, he can avail himself of several advantages, among which are a better labor market, a continuous organization and a lesser idle plant charge. To offset these are the disadvantages of unfavorable weather and the expense of providing against it, and the increased capital charge—bond, insurance, profit, overhead, etc., a fixed percentage for a longer period. It isn't unreasonable to expect that labor do its prorated share toward making the work both economical and profitable.

City Work.*

During the past year and one-half the Department of Public Works has been making an extended study of the possibility of so adjusting its operations that street and sewer work may be carried on partly during the winter months. The construction of hard-surface pavement during the rainy season is unquestionably improper, as it is practically impossible to secure a firm and even foundation for the pavement. Attempts to lay concrete pavement in cold weather have generally been unsuccessful and the danger of injury from frost or retarded setting is always present. With care, sewer work may be prosecuted during the winter months and objections to letting such contracts during the winter are therefore not of great importance—in fact, contractors on sewer work employ quite as many men during the winter months as during the summer months. While no difficulty has been experienced in securing work during the winter from sewer contractors, contractors for all kinds of street improvements are not disposed to commence their work unless clear weather be assured, and this department has not felt justified in calling for execution of contracts if the weather be unfavorable.

The following table showing the average number of men employed by contractors on street and sewer improvements was originally prepared for Dr. O'Hara in connection with his report on seasonal employment in Oregon. Some additional data are included covering the period after the report to Dr. O'Hara.

*By R. G. Dieck, Commissioner of Public Works, Portland, Oregon.

Employment on Street Improvement Work During 1914.

Date	No. of laborers employed during month	Value of work accepted at end of month
Jul. 1913	776.....	\$219,246
Aug. 1913	885.....	470,509
Sep. 1913	876.....	351,280
Oct. 1913	872.....	500,307
Nov. 1913	834.....	458,437
Dec. 1913	540.....	213,517
Jan. 1914	212.....	52,132
Feb. 1914	140.....	54,940
Mar. 1914	122.....	872
Apr. 1914	230.....	7,192
May 1914	422.....	84,411
Jun. 1914	565.....	96,496
Jul. 1914	359.....	23,167
Sep. 1914	386.....	.....
Oct. 1914	440.....	.....
Nov. 1914	246.....	.....
Dec. 1914	179.....	.....

Sewer Construction.

Jan. 1914	125.....	\$100,000
Feb. 1914	125.....	105,000
Mar. 1914	140.....	105,000
Apr. 1914	172.....	108,000
May 1914	185.....	115,000
Jun. 1914	190.....	120,500
Jul. 1914	175.....	115,742
Sep. 1914	103.....	100,000
Oct. 1914	212.....	125,000
Nov. 1914	172.....	100,000
Dec. 1914	85.....	50,000

The whole matter of seasonal employment is of much interest to me and when your plans have matured I shall be glad to have information of proposed measures to correct this condition.

Irrigation Work.*

This work is mainly confined to the arid or semi-arid sections east of the Cascades. It consists:

- (a) Of earth and rock excavation and embankment work required in the construction of or in building dams;
- (b) Of concrete masonry for dams, headgates, canal structures, lining, aqueducts or canal lining;
- (c) Of structural iron or steel work in hydraulic and electric machinery, in gates or other op-

erating apparatus controlling the flow of water or developing power from same.

In the arid section the effect of wet weather in preventing work is small or non-existent; the winter cold is however a factor to be dealt with. It may be stated broadly that all excavation of earth and rock can be carried out as a rule more advantageously during winter than summer, due to the fact that the cooler temperatures tend to greater activity of men and animals, and also because work stock can invariably be hired at cheaper rates.

Exception must of course be taken to irrigation construction work located in the higher mountain country or to any locality where the snowfall is deep and continues on the ground or where the earth becomes wet and freezes hard. These conditions are however exceptional in eastern Oregon, where usually the winter precipitation is very light and the earth does not become frozen hard.

I have known trouble to arise in building earth dams during the winter time in eastern Oregon where the specifications required earth to be sprinkled and rolled for compacting. It is my opinion however that the requirement of sprinkling and wetting before rolling is generally a useless one, as the earth can usually be compacted just as well dry as in a moist condition.

The placing of concrete in the winter months is however attended with so much risk and extra expense required for protection that it is not justified save in cases of emergency. In building large masonry dams, however, there is no substantial reason for stopping work due to winter weather, as the concrete is deposited in large masses that will not freeze.

The installation of machinery of all kinds can be as well carried out in the winter as in the summer months, save in remote mountain regions where transportation is rendered difficult.

On the whole it may be stated that a very large part of irrigation engineering work, perhaps more than one-half, can be advantageously carried out in winter time, possibly even more so than in summer.

Land Leveling.*

The feasibility of leveling land during the winter is dependent largely on conditions of temperature. In this vicinity,

*By Herbert D. Newell, Project Engineer. U. S. R. S.

(Hermiston, Ore.), however, usually it is more advantageous to level land during the winter than at other periods. In times of extremely cold weather leveling cannot be done to advantage. Most winters there is a period of from two to four weeks when earth work cannot be profitably carried on, and occasionally this interval is longer. On the other hand, some winters there is no delay at all on account of cold weather. I understand that during the winter of 1905-06, the contractor engaged in building an important canal in this vicinity worked the entire winter, and only lost a day or two. During the winter of 1913-14 the force engaged in excavating the main canal of the West Extension worked the entire winter with no delays because of frozen ground.

Except at infrequent intervals when the ground is frozen too deeply to be plowed, excavation and leveling can be carried on more cheaply during the winter than at other periods. As the ground is moist, material can be loaded more easily and less rolls from the scrapers than at other seasons. Men and teams can work more vigorously than during warmer weather. Again, stock drink less; this is not an unimportant item when work has to be done at a considerable distance from water.

In leveling land it is advantageous to open a considerable area at one time. This can best be done during the winter months as there is less danger from wind. Not only is the wind movement less during the winter months, but what wind occurs does less damage on account of the moist condition of the soil. If ground is leveled during the cool months, then protected by hay, straw or manure, it seems to me the work will be done at a minimum cost and with less likelihood of wind damage.

Another reason why leveling can be advantageously done in the winter months arises because of the very condition which brought about this discussion, that is, men and teams can be hired more cheaply during the winter than at other periods. So far as trams are concerned, stock must be fed in any event, and very commonly those having stock which can be used for miscellaneous farm work during nine months of the year are glad to work them during the winter for little more than board. At present (January, 1915) there is much leveling in progress, due almost entirely to the reasons just indicated.

*By E. G. Hopson, Supervising Engineer, U. S. R. S.

Land Leveling for Cultivation.*

This branch of engineering or agricultural work is governed by conditions practically identical with those governing the building of earth dams and canals. There is however, one element of difference, viz., that it is generally important in localities where the soils are light and dry that the newly turned earth be wetted and seeded to obtain growth to prevent wind erosion. The winter months are usually ideal for this class of work in eastern Oregon, and all operations of this kind can advantageously for the work be reserved for this period.

Drainage.*

This work usually involves large machine operation. The proportion of labor involved is relatively small. The most common types of dredge are the dragline and the orange peel, or clam shell, for large open drainage channels in marshes or bottoms. This work can usually be carried out just as well in winter as in summer in Oregon, save when exceptionally severe cold occurs and the ground is frozen for several feet. In deep drainage channels, however, a thin superficial crust of frost is no particular hindrance to dragline work. In general it may be stated that possibly 75 per cent of this class of work can be carried out in Oregon in winter time under conditions as advantageous from the economic standpoint as in summer.

Highway Construction.*

Highway construction east of the Cascades can to a very large extent be carried on equally well in winter as in summer. All kinds of grading, embanking, draining and surfacing can be performed to the highest advantage during the winter months, with the possible exception of bridge work and surfacing requiring the use of concrete masonry. Concrete culverts and bridge work should not be done in cold weather unless thoroughly protected against frost, which generally is unduly expensive. However, with some little adjustment of the construction program, the structures can generally be arranged to be built in advance of or subsequent to the rest of the grading and surfacing work, so that winter work can be arranged for economically.

West of the Cascades, all grading save rock work and wheel-

*By E. G. Hopson. Supervising Engineer, U. S. R. S.

barrow work is liable to be markedly less economical and satisfactory in winter than in summer. Exceptions to this rule will of course be found, particularly in cases where there are heavy cuts or machine work, but the rule is probably of general application in the humid section. It so happens however, that masonry work and concrete surfacing and macadamizing west of the Cascades can be performed almost as advantageously in the winter season as at other periods. It might therefore be wise to arrange highway construction west of the Cascades in such manner that the grading work will be done during the dry season, and the structures and a large part of the surfacing in the less favorable portions of the year. Whenever possible, contracts should cover a full year, so that each kind of work may be done during the season best suited to it.

Water Works.*

Water works construction may be divided into two classes, the first being the supply system outside of the city and the conduits leading from the supply system to the city, the second the distributing system within the city itself.

As a general rule city supply works are located in the higher and more mountainous sections in order to obtain mountain supplies. In such localities construction work of all kinds necessarily has to stop during the winter months, largely due to inaccessibility as well as to the heavy snowfall and frost. As a matter of fact, in this State there are no large water supply systems likely to give employment to big bodies of men. The only large city (Portland) has a supply that has recently been supplemented by a new steel pipe line, so that little additional construction work will be required in its supply system during the next few years. The other cities in the State are smaller, with comparatively unimportant works constituting their systems.

The construction and repair of the various distributing pipe systems in the different cities entails the employment of a great deal of labor in the aggregate. Usually pipe work in Oregon can be laid as advantageously in winter as in summer. So far as practical, it would be well to arrange for winter work in new extensions of the systems, but necessarily such a rule cannot always be followed, as first consideration must be given to the communities waiting for a water supply, for it would obviously be unreasonable to keep people waiting for a necessity of life

*By E. G. Hopson, Supervising Engineer, U. S. R. S.

for the mere purpose of favoring construction in one season as against another. It is, however, probable that the city departments can accomplish very useful results if the importance of winter operations be borne in mind by them in laying out their construction programs.

Underground Electric Work.*

We have no accurate data covering the subject of comparative costs of underground work done in the winter and in the summer, but we believe that it costs us from fifteen to twenty per cent more to do trench work in the winter time. This is on account of rains, which make it necessary to employ extra men to keep water out of the ditches, the additional cost of handling the dirt when wet, the inconvenience of working in the rain, etc.

We believe that there will be very little difference in the cost of laying ducts and installing pipes, whether done in the winter or summer.

Clearing Land.

All business originates in the land or the water.

In the Northwest there are four primary occupations. Every industrial activity begins with the lumberman, the farmer, the fisherman or the miner. What business needs now is more men to start things, more men who can employ themselves and later will employ other men.

Lumbering is out of reach of the poor man. Fishing requires special skill and endurance, and can employ only a few, and for part of the year only. Mining, without capital, offers only an uncertain livelihood. What about farming? Does someone say that we have too many farmers now? Whoever says so does not know that in these days it is not individuals that compete but communities. We lack markets, not because we produce too much, but because we produce too little.

But when the man without money turns to the farm he finds it almost as far beyond his reach as the mill or the bank. To buy land, stock and machinery, seed and supplies, takes no inconsiderable amount of capital. Before we can solve this problem we must realize that Oregon in spite of its development is still three-fourths wilderness. We must revive the pioneer spirit.

*Northwestern Electric Company, Portland, Oregon.

Nearly all of the farms of Western Oregon, at least, were carved out of the forest by men without capital, without other employment, without markets, without resources except their own hands and brains. No man of today need face such physical difficulties as did the men of the 50's who made Oregon a state.

There is no farming community in the State where an industrious man of moderate strength, with or without skill, cannot find work for at least six months in the year, at wages that will supply himself and his family with the necessities of life. In very few sections west of the Cascades will such a man have any difficulty in finding ten acres or upwards of logged-off or timbered land, which he can buy on credit, at a reasonable price. He is then ready to become his own employer during all the time that he is not working for wages.

To the man unskilled in such labor, the clearing of western Oregon stump lands is a formidable task. To the man who has tried it without obtaining advice it is a nightmare. To the man who has tried to hire it done—don't mention it! But if we are to make any progress, this work must be done, and it can be done. It can be done on a large scale with machinery and organized forces. It can be done on a small scale as cheaply but more slowly; not by the proverbial man "with a strong back and a weak head," but by the man with two good hands and a head which he is not afraid to use.

Here are some rules laid down by a man who knows how to clear logged-off land:

1. Slash the brush, preferably in the summer when the leaves are on, and burn as soon as dry. Before burning dig around the large stools of vine maple and hazel and pile brush on them. The fire will kill the roots and they soon die out. The ground may then be seeded to grass and used for pasture for two or three years, during which time, the young shoots being eaten off, the bushes will die out, and the grubs can easily be removed. If the land is wanted for use at once, the bushes must be grubbed out instead of slashed.

2. Before tackling a stump, see that the rubbish is cleared away from around it so that it will not get covered up with earth. Then start a trench around the stump, from two to four feet in width, according to the size of the stump, and deep enough to get well below the plow. Cut off the side roots as close to the

trunk as convenient, and follow them out to where they will be below the plow or small enough to be torn out.

3. Place a charge of powder under the center of the stump, large enough to split it but not to tear it out. This will usually be about half the charge required to throw the stump clear out, but this amount can best be determined by experience. After shooting, dig the earth away from the center of the stump to a little greater depth, 18 inches or 2 feet, as fire will not take hold on anything that is not exposed.

4. Bank up around the stump with logs, roots, limbs, etc., to an extent equal to or greater than the size of the stump itself. If any slabs of bark are obtainable set them on edge around the pile thus made. Fill in the balance of the trench with earth so that all the heat of the fire will be directed against the main trunk.

5. Wait till midsummer.

6. Set on fire, give a little attention to keep the fires banked up and the pieces together as needed. A few hours will see the biggest stump reduced to a pile of ashes.

All of the above work except the burning, can best be done in the winter, when digging is easiest, powder most effective, and other work hardest to get. The back-breaking task of cutting off the tap roots and dragging the stump out of the hole is saved by the simple expedient of burning it where nature put it. The injurious effects of heavy shooting, throwing out masses of clay to damage the soil, are all avoided. No work is required which is beyond the strength of the average man. Even a team is not necessary, though convenient for "housing" the stumps with material for burning. Ten dollars will buy all the tools needed, and 50 cents a stump on the average will pay for the powder, though some will require much more.

A pound of example is worth a ton of precept. The experience of Mr. J. H. Dixon, who has worked out the rules given above, is worth relating. Fifteen years ago, at the age of 57, Mr. Dixon bought 160 acres of logged-off lands ten miles north of Vancouver, Washington, paying \$20 an acre. Since that time he has cleared 100 acres of it, fenced it, built a good barn, laid two and a half miles of drain tile, some of it 6 or 7 feet deep, besides farming the land as fast as it was ready, and has done 90 per cent of the work with his own hands. During much of

the time he has averaged a stump a day. Such results are not obtained without the use of a considerable amount of head work, but they are within reach of any man of grit, intelligence and reasonable strength.

Cyclical Unemployment.

Closely related to the subject of Winter Unemployment is that of periodical business depression, which greatly intensify the effects of seasonal idleness. The causes of "hard times" are not within the province of this report, but to some extent measures for their relief are of the same nature as those already discussed.

The great problem of civilization is to provide conditions under which all who will may find work, and may receive the fruits of their labor. It is a reproach to our standing as a progressive people that in a country filled with undeveloped resources, men should seek work and not find it. Much may be done to relieve this situation by the wise direction of public expenditures. It is essential that the burden of taxation should not be increased during periods of depression, but at such times state and municipal bonds usually command the highest prices and find ready sale. By selling bonds in excess of immediate requirements to an extent sufficient to provide for two or three years' interest, the increase of taxation can be deferred until the recurrence of "good times," which follow "bad times" as regularly as day follows night.

Not only is it easier to obtain money for public improvements during dull times, but more is accomplished with the same amount of money. The cost of obtaining labor is reduced to a minimum, and men are more eager for employment, and render better service for the same or less pay. Common business prudence dictates that there should be the least possible expenditure for public improvements during good times, and a maximum during hard times. By taking advantage, as it were, of hard times they will quickly disappear, the over-supply of labor will be absorbed and the haunting fear of idleness and destitution will be at least partly dispelled.

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

WATERPROOFING CONCRETE SURFACES

[From the Reclamation Record, April, 1915.]

Mr. J. L. Lytel, project manager of the Strawberry Valley project, Utah, records an interesting experience in waterproofing of concrete surfaces. The storage works and tunnel of the Strawberry Valley project are located in the Wasatch Mountains at an elevation of 7,500 feet. There is a wide variation in temperatures in this vicinity and the climate is very severe during the winter months, the lowest temperature on record being 50° below zero. The snow fall ranges from 10 to 24 feet in depth.

The extreme cold, with alternate thawing and freezing of water in the ports of the exposed faces of the structures, was found to have a very destructive effect on these concrete structures and the waterproofing of the surfaces was decided upon as a preventive against their continued disintegration.

It was decided to treat the vertical surfaces with alum and soap solutions and the horizontal surfaces with paraffine. The alum solution was made by dissolving 2 ounces of alum [$\text{KAl}(\text{SO}_4)_2$] in 1 gallon of hot water. The soap solution was composed of three-fourths pound of castile soap dissolved in 1 gallon of hot water. The paraffine was boiled to drive off water as the presence of water rendered it hard to apply. Ordinary commercial products were used.

The surface to be treated with paraffine was first thoroughly dried and cleaned of loose concrete, dirt, and other foreign substances. The paraffine was then heated and applied with a paint brush, and was forced into the pores by the heat of a blow torch on the surface. Only one coat of paraffine was applied as the concrete would not absorb more.

The surface to be treated with soap and alum was prepared as above stated. The alum solution was applied at a temperature of 100° F. with a moderately stiff brush and was then worked in with a stiff horse brush. While the surface was still moist from this treatment the hot soap solution was applied in the same manner as the alum solution. One treatment by each solution in the manner described above constituted a coat. If other coats were considered necessary, they were applied in like manner after the preceding coat had been allowed to stand 24 hours or more.

Twelve structures were given this treatment, the surface area

covered being approximately 28,000 square feet. Four thousand square feet were treated with paraffine, at the rate of 1 pound for $11\frac{3}{4}$ square feet, and the remainder with soap and alum. It required 1 gallon of alum solution and a half gallon of soap solution to cover 50 square feet with two coats. Two coats of alum and soap were applied at an average total cost of 75 cents per 100 square feet, and the cost varied from 41 cents minimum to \$1.28 maximum. The cost of one coat of paraffine varied from \$1.70 to \$3.78 per 100 square feet, and averaged \$2.11. This cost covers everything except general expense. The two men who did this work received \$75 and \$80 per month. Brushes cost \$6.06, Castile soap $12\frac{1}{2}$ cents per pound, alum 18 cents per pound, and crude paraffine \$4.80 per hundred-weight.

The results obtained by this style of waterproofing are considered very satisfactory. The structures that were repaired and treated have gone through two severe winters and no further disintegration of the concrete on any part has occurred.

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

ARCHITECTS VERSUS ENGINEERS

ILLINOIS ENGINEERS WIN FIGHT FOR LEGAL RECOGNITION

The war waged by the engineering profession in Illinois to secure equal rights with the architects in the designing of buildings and structure requiring engineering calculations is believed to be of sufficiently wide interest to justify the publication here of the letters and arguments which were issued by the Legislative Committee of the Western Society of Engineers and of the Act which was adopted by the State Legislature, June 19, 1915.
—Editor.

Letter Addressed to the Members of the Western Society of Engineers.

March 3rd, 1915.

Dear Sir:

Your Board of Direction encloses to you draft of a bill it is proposed to support in this Illinois Legislature.

As we see the matter, this proposed bill is purely in the interests of the engineering profession, since it is aimed toward the correction of what seems to be an intolerable situation in the matter of the design of buildings and structures and the relation of engineers thereto.

The features of buildings and structures which are of most importance from the standpoint of the safety of the public, are worked out by engineers and by the application of engineering principles; namely, those features of the structures which have to do with their stability. Notwithstanding this fact, in our State the engineer unless he has an architect's license has no legal right to design buildings and the structures pertaining thereto for erection in our own state, and as the law is interpreted by some, for erection in any other States of the Union. Also, it is not lawful for a firm which is established for the design of buildings and the structures relating thereto to be composed of an architect and an engineer, but all members of such a firm must be licensed architects; this notwithstanding the fact that it is the principles of engineering which enter into the design of the building in those features that have to do with the safety of the public.

We regret that it seems necessary, in order to overcome unreasonable disabilities under which the engineer now works in the matter of the design of the buildings and structures, to propose the introduction of licensing structural engineers, since as a general proposition we believe that license laws for engineers are not likely to be conducive to the public good, but with the situation as we find it in Illinois and after very careful study of the matter, we find no other practicable way to overcome the unreasonable limitations under which the engineer in connection with the design of building and structures now operates.

After completing draft of a proposed bill, our Legislative Committee met with committees of the Illinois Society of Architects and the Illinois Chapter of the American Institute of Architects, and on account of these conferences made material changes in their original draft of the bill to accord with the views of these committees.

Naturally in the progress of such a bill as this through the Legislature, there are likely to be found necessary some changes in its pro-

visions, the general supervision of which possible changes has been placed in the hands of the Legislative Committee by the Board.

After having read the draft of the proposed bill for licensing structural engineers and in the light thereof and the statement that we have made above for your information, won't you promptly designate on the enclosed postal card whether you approve the introduction of such a bill in our Legislature, and in case you do not, won't you kindly set forth, either on the postal card on in a letter, your reasons for opposing such a plan.

Please have your postal card mailed to us at a date not later than Monday, March 8th, so that this referendum vote may be promptly tabulated.

Cordially yours,

BOARD OF DIRECTION
WESTERN SOCIETY OF ENGINEERS,
Wm. B. Jackson, President.

Second Letter Addressed to Members of the Western Society of Engineers.

April 22, 1915.

Dear Sir:

The bill for licensing Structural Engineers is now before the Committee of "License and Miscellany" of the State Legislature. Our Bill is House Bill No. 406.

A spurious bill has been introduced as House Bill No. 618 by the opponents of our measure in an effort to cloud the issue and perhaps secure the passage of a bill which would not at all serve the purpose intended by our own. Please see to it that your friends in the Legislature understand that House Bill No. 406 is the one which is being promoted by the Legislative Committee of the Western Society of Engineers.

The opposition to our bill is extremely active. It appears that practically all the Architects in the State are working against it. Their activity has been fomented by a number of circulars and letters attacking our bill. Most of the arguments which they advance against it are based on a misunderstanding of our purpose and misinformation as to the provisions and effect of our bill. In order to correct these misunderstandings and misinformation we are issuing an open letter to the architects, of which we enclose herewith a copy.

We enclose herewith a list of the Members of the Committee which has our bill, and also a list of all the members of the Legislature.

It is now time to use every means available to get the correct information before the members of the Legislature and particularly to enlist the support of the members of the Committee. It should be particularly emphasized that we are seeking this legislation as a matter of right and to correct a matter of long endured injustice.

Very truly yours,

LEGISLATIVE COMMITTEE OF THE
WESTERN SOCIETY OF ENGINEERS.

An Open Letter to the Architects of Illinois, Regarding the Proposed Engineers' License Law.

Gentlemen:

We are addressing this letter to you in order to remove, if possible, some misconceptions of our position and in the hope that your spirit of fair play will permit you to give this letter your earnest and careful attention.

1. It is not the intention of the bill to repeal or destroy the present

Architects' License Law and we are advised by competent legal authority that it does not do so.

2. Engineers do not want to practice architecture. If they did, they would attack the administration of the Architects' Laws and demand licenses as Architects on a strictly engineering examination—relating to public safety and sanitation, which is admittedly the only ground upon which the right of the State to grant exclusive license can be founded.

3. As long as Engineers have no right to represent themselves as Architects, there will be no unfair competition between Architects and Engineers, and the Owner will be free to employ an Architect or an Engineer as the character of the building or structure demands and will know which one he is employing. The name "Architect" should be a sufficient protection to the profession of architecture.

4. We believe most architects will admit that the safe and economical design of modern steel or concrete structure of the first class goes far beyond the training and experience of the average Architect, and that *mere safety* would be conserved *so far as the public is concerned* if such structures were designed by Engineers.

5. The planning of plumbing, lighting, heating in the hands of the Engineer who has completed a course in hydraulic and sanitary engineering and thermodynamics required in courses in Structural Engineering and who presumably understands the underlying principles of these subjects, is certainly just as safe as in the hands of the Architectural Graduate, who is only acquainted with the A B C's of the application of these sciences to buildings.

6. The Architects' Engineering, is "Handbook" Engineering, and rightly so, for the Architect has other and higher things to look after. But it is the Engineer who writes the "Handbook" on which the Architect has to lean. Why deny to the Master the rights given to the pupil?

7. We go further and maintain that the "Master Mind" in the planning and design of a building should sometimes be the Architect, sometimes the Engineer, and sometimes neither one, as for instance a Doctor planning a Hospital. It is impossible to divide work between the Architect and the Engineer on a trades-union basis. If you don't believe this try it yourself and see.

8. The training and experience of the Engineer eminently fits him to plan and design buildings and structures for manufacturing and industrial purposes, and we maintained that so long as he is not allowed to call himself an Architect no unfair competition is involved.

9. The proposed law is open to no more objections than the Architects' Law, in that it will admit without examination those now practicing structural engineering. The ultimate standard will be higher, because of the requirement of six years' practical training and experience. How can the Architects defend their law that admits many graduates of Architectural Schools to the practice of Architecture immediately on graduation. No one should pretend to competence in independent planning and design until he has had a thorough practical apprenticeship in addition to his college training.

10. When the Governor appointed a Commission to codify the building laws he appointed two Structural Engineers, two Architects, of whom one was also a Structural Engineer, and a Contractor. When the City of Chicago or New York, or any City having a competent building department, examines plans for building permits, who examines the plans? Engineers—and what plans do they principally examine? Engineering plans, which are usually prepared by engineers in the Architect's employ. All the beautiful ideas of architectural expression count for nothing. The examination of the other plans is confined to the technical compliance with building regulations, which are largely formulated by

Engineers. You cannot possibly claim that the Engineers are not competent. As a class they know far more of the principles of construction than the Architects, and frequently as much of the practice, and for that matter there are many contractors and builders who know more of the practice than most architects or engineers.

11. As to Corporations, the Engineer frankly differs from the Architect who states broadly that "professional service is necessarily personal service." We fail to understand why the corporate form of organization should be denied to associations of engineers or, for that matter, to architects, where this form of organization gives continuity, stability and responsibility, and enables a firm to construct as well as to plan and superintend. You will note that we have been careful to limit the enjoyment of these privileges to corporations in which the "Chief executive officer or managing agent" is a licensed Structural Engineer, which means that such corporations will have to be true engineering organizations.

12. We are not hostile toward the Architects. We would like to see more good architecture in so-called engineering structures as well as more good engineering in so-called architectural structures. Give us our License and place the two professions on the same basis, and we shall see cordial co-operation between them. We have much to learn from architects in proportion and outline, and the architects have much to learn from us in sincerity of expression. If we attempt to divide the field arbitrarily there will be nothing but trouble for both professions. If we have equal rights there will be partnerships of architects and engineers and a new start given to both professions. A monopoly in either profession only means deterioration.

13. The architects greatly underrate the temper of the engineers if they think that the demand for equal privileges comes from a small faction, or that they will be easily turned from their determination to obtain their rights. We would like to join the Architects in a movement to draft a new law registering both Architects and Engineers and providing a State Building Code with strict requirements to secure safety in building, but we see no prospect at present of such a happy solution and are therefore convinced that delay would only mean hazarding the main issue which we regard as a matter of *Right* and the correction of a long-suffered injustice.

Respectfully submitted,

LEGISLATIVE COMMITTEE OF THE
WESTERN SOCIETY OF ENGINEERS.

Open Letter to the Owners of Buildings in Support of House Bill No. 406 to License Structural Engineers.

To the public and to the owners of buildings the enactment of the proposed Engineers' License Law is of the greatest importance. It will enable them to engage an Engineer instead of an Architect to handle building work whenever the building is of an engineering character, and it will enable them to select their own Engineer when both Engineer and Architect are required.

First. The Owner will have a greater number of competent specialists from whom to select the Architect or Engineer to design and supervise his buildings.

Second. The safety of buildings of the first class depends *now* upon the Engineer, *who can only serve as an employee of the Architect*. The proposed bill will make the Engineer *directly* responsible for the work he is doing now, and the Owner will know that he is getting the right

kind of service. The Owner should insist upon the right to select his own Engineer. This bill gives him that right.

Third. The law will require six years' practical experience, or equivalent of anyone calling himself an Engineer, the Owner will know he is getting a man of training and experience. Under the Architects Law a boy just leaving college can obtain a license by passing the examination far more easily than a seasoned and experienced Architect.

Fourth. Where large or high buildings are built of Concrete, Steel or other modern materials, the Owner is entitled, for his own protection, to the services of a competent Engineer, and under the provisions of this bill the selection of the Engineer will not be left to the Architect, but the Owner can select his own Engineer if he desires to do so. Or a firm of Architects and Engineers can be employed which will be made possible under the proposed law.

Fifth. Engineers are trained in economical and efficient construction; one definition in Engineering is the "science in construction by which a dollar is made to earn the most interest." This definition is at the heart of Engineering efficiency.

Sixth. The Engineer is therefore the man to whom an industrial building should usually be intrusted, because he is specially trained to study true economy of construction and adaptability. The Architect should hold a secondary place in buildings of this character.

Seventh. The effect of the proposed Law will not be to increase the cost of building. On the contrary, it will more than likely decrease the cost of building, through the employment of another class of professional men (the Engineers) specially trained in economy of construction.

Eighth. The law will be self-supporting and may even be source of revenue to the State.

Ninth. The only way in which an Owner can now secure the services of an Engineer in the design and construction of buildings is to employ him as a Contractor, which is allowed by the existing law. This bill will enable the owner to employ him professionally and thus secure engineering service unchanged by commercial influence.

Respectfully submitted,

LEGISLATIVE COMMITTEE OF THE
WESTERN SOCIETY OF ENGINEERS.

Letter to the Members of the Illinois Legislature.

Gentlemen:—The Engineers of the State of Illinois come before you and ask favorable action of House Bill No. 406, Entitled

A Bill for An Act to provide for the Licensing of Structural Engineers to regulate the practice of Structural Engineering, and to exempt licensed Structural Engineers from the provisions of the Act relating to the practice of Architecture.

The designing, supervising and constructing of buildings and structures, including many of the largest and most important, comes legitimately within the proper function of the Engineer, and is a part of the work for which he is especially trained. In the State of Illinois, through the existence of a monopoly created from doing this work professionally (that is to say for others, by the Architects' License Law, the Engineer is legally debarred

the work to be constructed by another), and has been forced to either of four courses:

1. To operate as a Contractor, by taking advantage of a loophole in the Architects' License Law.

2. To work for an Architect, in which case the public does not get the full benefit of his services, and he gets neither the recognition nor the reward.

3. To practice his profession in defiance of law, in which case he becomes a lawbreaker with no rights to collect his compensation in court, and subject to fine any time the Architects' Board decides to attempt the enforcement of their law against the design of Engineering structures.

4. To forfeit his professional identity by seeking license under the Architects' Law, thus representing himself to be an Architect when in fact he is not, would be contrary to public policy as well as to the best interests of both Architects and Engineers.

We believe we have exhausted our efforts to obtain relief in other ways and now come before the Legislature in full confidence that our rights will be protected and the disability under which we have so long suffered removed. We ask for a license law for "Structural Engineers," giving them the same rights now enjoyed by Architects as applied to buildings and structures requiring Engineering calculations. We have drafted this bill under competent legal advice so that it will not invalidate or destroy the Architects' License Law. We see no reason why Architects and Engineers cannot be licensed under separate laws and both enjoy the same rights and privileges as applied to building as defined in these separate acts.

In line with the foregoing we submit herewith the following brief outline of our case and trust that it will receive your earnest attention.

- (1) The only valid basis for an exclusive license lies in the police power of the State to protect the safety and health of its citizens. On this theory it is proper to license certain professions having special skill in certain directions, and to give them the exclusive right to practice such professions under State regulation. *Such license must, however, be open to any applicant who can show that he is possessed of the necessary skill, and*

must not be used to create a professional monopoly, or to promote a certain code of professional ethics.

(2) Strength and Sanitation are, therefore, the only possible grounds for a license to design, supervise and construct buildings and structures. The Architects claim that their profession is the only one possessing the necessary skill and training for this work. Their claim is manifestly absurd. As a matter of fact, *all buildings of the first class* depend for their strength, safety and health upon the *Engineer* and not the Architect at all. The public should demand the right to place responsibility for strength, safety and health directly upon the shoulders of the Engineer, who is the only man competent to carry it.

(3) The Engineers are a body of highly trained professional men. Their training and education is based on a thorough and scientific understanding of the nature and application of *natural laws*. Most of the material progress of the 20th century has come through the Engineer. They have designed our machines, built our bridges, constructed our railroads, planned our public utilities, sewer systems, waterworks, electric plants, and industrial establishments. They have successfully met the demands of this commercial age, and as soon as the construction of buildings of unprecedented dimensions began to demand scientific skill and experience in their design, the Engineer stepped in and made these things possible.

(4) Safety of large buildings demands that Engineers should design them. The Architects have employed Engineers for this work because they could not get along without them. But the public now has no guarantee that a competent Engineer will be employed. There would be good reason for *requiring* the employment of an Engineer on all buildings over a certain size, but we believe that the competition between Engineers and Architects will practically force this, or will lead to a partnership between Engineers and Architects which is the best possible arrangement. At any rate we hold that the man responsible for the strength and safety of a building should have the right to design it, and that the state should examine and license him for this work.

(5) The Engineering profession is behind this movement. This Bill has been drafted and is being promoted by the Western Society of Engineers, which has a membership of about 1,200, mostly residents of Illinois. It has the endorsement of the en-

gineering professors of all the engineering schools and colleges of the state.

(6) The Engineers are not asking the state to incur the least expense in connection with the proposed law. The Bill has been drafted so that the operation of the law will be entirely self-supporting, and a sufficient number of Engineers have already signified their intention of applying for license to assure that this will be the case.

(7) We ask a law for Engineers rather than to apply for Architects' licenses under the present Architects' License Act, both on the *grounds of public policy* and of *professional integrity*. We decline to accept licenses that might be granted by a Board of Architects, as the Architects are not competent to pass on the qualifications of Engineers. We refuse to practice under the name of another profession. The public must know whether a man is an Architect or an Engineer—the names of both professions must be protected.

(8) The difference between the Architect and the Engineer is a very fundamental one. The former is more the artist, the latter the scientist in relation to planning and design. The field of building cannot be divided up between the two professions because there is no possible dividing line, and because the rights of the public would be wholly ignored in such attempted division. The owner will call in an Engineer or an Architect, as the case may be, depending on the uses and character of the building, and he should have the privilege of doing so.

(9) The Architects are fighting this bill in the mistaken idea that it is hostile to them. We do not want to put them out of business. We only want the right to do *under our own name what our professional experience fits us to do*. We are against monopolies of all kinds and want no monopoly for ourselves. We would be satisfied so far as we are concerned with the repeal of the Architects' law, but we are not asking for its repeal, because their law, even as it is, tends to protect the public in the absence of a comprehensive state building code. We only want a fair field open to all those who are competent.

(10) As to the provisions of the Bill, you will note many salutary provisions for protection of the public and for raising the standard of the Engineering profession. All candidates for license are required to have experience as well as education, and

corporations, now unlicensed as Engineering Contractors, are brought under the provision of the Act.

(11) In proposing this Bill, we have incurred quite unexpectedly the bitter opposition of the Architects, who resent our effort to obtain our rights in a field which they have attempted to monopolize. They are conducting a campaign of misrepresentation, and have even gone to the length of introducing a spurious Engineers' License Bill—House Bill No. 618—in an effort to cloud the issue. Such tactics before your honorable body cannot fail to react against them.

Respectfully submitted,

LEGISLATIVE COMMITTEE OF THE
WESTERN SOCIETY OF ENGINEERS.

Second Letter to the Members of the 49th General Assembly.

May 20, 1915.

Gentlemen :

It is not necessary to go outside the Architects' own authorities to find the very best reasons for a separate Engineers' License as provided for in House Bill No. 406.

The standard authority "*A Dictionary of Architecture and Building*" by Russell Sturgis defines Engineering in relation to Architecture, as follows: "*The study and pursuit of mechanical or constructional occupations according to theoretical and strictly scientific principles, as distinguished from similar work done by traditional or empirical methods. . . . modern iron construction, except in its simplest form, as in the laying of a floor of rolled beams and the hanging of fireproof flooring, is commonly left for the plans or specifications, or both, of a professional engineer; and that because it is necessary to have a recognized factor of safety, and yet not to overpass it too much on account of the great cost of the material and workmanship.*"

"In a general way the division between the Architect's and Engineer's work may be expressed in this way: Whatever is traditional in form and structure, whatever is admittedly safe, whatever is known to all practical builders as well within the limits of danger, comes within the Architect's province; and nearly all his more important artistic results are procured from the treatment of such buildings as this. All that is so new or so complex as to require careful scientific examination based upon mathematics is the province of the engineer. Some, but not many, modern architects are themselves competent, and, up to a certain point, may trust their own computations,"

In spite of their own highest authority the Architects of Illinois claim that the Engineering profession is not entitled to a separate existence and that the Engineer becomes an architect when he engages in the design and supervision of a building.

The above definition expresses the exact truth and has been followed very closely in Bill No. 406. Manifestly an engineer ought to have the right to design and supervise a building requiring engineering calculation. If we were inclined to favor a division between architectural buildings and engineering buildings we should argue that the *Architect should have the right to design only the admittedly safe and traditional,*

for "some but not many modern Architects are themselves competent, and up to a certain point, may trust their own computations."

The Engineer is the authority on Construction. Any intelligent man can follow precedent, but it takes an Engineer to design a building when it exceeds the "admittedly safe as known to all practical builders." The Engineer should therefore have at least the same rights before the law as the Architect, and his qualifications should be passed upon by a "jury of his peers."

The above references and deductions establish the proper position of the engineer from the architect's own authorities. What about the Architect? Let us quote from a report of the Committee on Legislation to the 48th Annual Convention of the American Institute of Architects. It says "*We believe: that the present laws are deficient in not covering in their definition of an architect, what an architect is. Most of the present laws define the qualifications of an architect in a way that would lead the public to believe that his principal duties are along structural and sanitary lines. . . . The Architect's most important qualifications should be ability in the Art of building, and the science of building should be secondary. The Architect is not the highest authority on construction or sanitation, but he should be on planning, grouping, design and color. Are not these latter requirements more necessary of possession by architects to help the public toward better architecture than knowledge of trusses and plumbing? . . . Architecture in its highest sense is a fine art and the public will accept it as such if it is within our laws. . . . An Architect is one who designs buildings with a knowledge of beauty and economy as applied to them.*"

We also endorse these recommendations in every detail, but in order to preserve their legal monopoly the Architects of Illinois have posed as experts on "trusses and plumbing." Their examinations contain just enough draftsmanship, historic orders and definitions to keep out the Engineer, but only enough engineering to keep out the notoriously unqualified. In this way they have accomplished only a fraction of the good which their law might have accomplished.

Let there be two laws—one licensing Architects and requiring thorough examinations in "*planning, grouping, design, and color*" with the rudiments of engineering as at present, recognizing the Architect for what he is—the artist of building—and one law licensing Structural Engineers and requiring a thorough examination in engineering together with the rudiments of design, recognizing the engineer as the Scientist of building. The Public will know that the engineers' license and the architects' license are both certificates of competence in their respective professions. At present the Architects' license means very little on the Art side and practically nothing on the engineering side of building.

The operation of the Architects license law in Illinois today is full of absurdities.

Mr. Barton, Secretary of the State Board of Examiners of Architects, stated to your sub-committee that they were seeking to put out of business such competent and responsible engineering corporations as the Arnold Co., the John S. Metcalf Co., James Stewart & Co., The Leonard Construction Co., Westinghouse, Church, Kerr & Co., etc., firms representing in the highest degree engineering attainments, fair dealing, and responsibility. At the same time they are licensing each year hundreds of applicants, a majority of whom are boys and girls hardly out of their teens whose chief ability lies in clever draftsmanship and who are absolutely without experience or adequate training to fit them for the responsibilities they are undertaking. Bill No. 406 makes practical experience and training the first requirement, so that an Engineer's license will mean

something. *It recognizes the Engineering Corporation officered and operated by Engineers, as the most efficient and responsible modern agent for "designing and supervising buildings and structures for others," and brings it within the law.*

The Architects law has encouraged manufacturers of building materials to engage in the design of engineering structures for Architects. We make this statement with full knowledge of the facts. The Architects as a class are not generally competent to design safe and economical structures in reinforced concrete and steel and, because of the monopoly they enjoy, are greatly tempted to decline to employ professional engineering services for which they would have to pay, when manufacturers will do the work for nothing if the Architects will specify their materials. These abuses are strongly opposed by the Architectural Societies, but exist in spite of them and will continue to exist until Engineers are allowed to practice their profession openly. When House Bill No. 406 becomes a law, the owners of buildings will find it possible to engage professional engineering services directly and it will not take them long to realize its advantages.

The foundation plans for the freight house of the new Pennsylvania R. R. terminal in Chicago were prepared and executed by the engineering department of the Pennsylvania Company, and last week a building permit was refused because the plans did not bear the stamp of a licensed architect. (It is not likely that there are a dozen licensed Architects in Chicago, barring those engineers who hold architects' licenses, competent to make plans of this kind.) Finally an Architect's license was granted without examination to Thomas Rodd, Consulting Engineer of the Pennsylvania Company, and the permit was issued. How absurd that high class engineering plans should have to come in under a subterfuge of this character. He should not be required to represent himself as an Architect, which he is not.

The Architects of Illinois have put themselves in a false position and are fighting against their own best interests. They are not following their own great leaders—The "*Artist in building*" requires no legal monopoly.

Some of them hardly seem to know what an engineer is. Robert Bruce Watson at the public hearing before your sub-committee in Chicago on May 1st, said that "*the engineers reminded him of the boy at the soda water fountains who had seen the registered Pharmacist putting up prescriptions so long that he thought he thought how and wanted a chance to try his hand at it.*" No comment is necessary. We have had to "*fetch and carry*" for the architect long enough but are resolved to do so no longer. We are waking up.

The Architects are representing that this bill will destroy "*the great profession of architecture.*" What can be more absurd. A great educator of this State when addressed in one of their hysterical communications merely remarked that "*so far as he could see they seemed to think that the Engineers were handing them over bound hand and foot to some enemy or other.*"

Gentlemen: They have no enemies but themselves. There is no real reason for any one to oppose this bill so strenuously. Their terrible predictions will be forgotten the instant this bill becomes a law and they will find the two professions soon working together in harmony, architects becoming associated with engineers here as in other states, and the character and economy of building operations materially improved, to the great benefit of the People and State.

We must again urge your support of this most important and much needed bill.

Very respectfully,
LEGISLATIVE COMMITTEE OF THE
WESTERN SOCIETY OF ENGINEERS.

Third Letter to the Members of the 49th General Assembly.

May 22, 1915.

Gentlemen:—

Our circular letter which was mailed to you two days ago contains a technical error at the top of the 4th page (near end of preceding letter). It appears that the License Stamp used on the plans in question was not a new one, but one which had lapsed and was renewed for this special purpose.

Thomas Rodds' name does not appear as a Licensed Architect in any of the recent official lists.

But do not let this cloud the point, namely; that the engineer who designed this work was compelled to procure by renewal or otherwise an Architect's License, and to call himself an Architect before his plans could be given consideration by the Building Department of Chicago.

Very respectfully,
LEGISLATIVE COMMITTEE OF THE
WESTERN SOCIETY OF ENGINEERS.

Fourth Letter to the Members of the 49th General Assembly.

Gentlemen:—

We have been greatly surprised at the strenuous opposition of the architects to House Bill No. 406 which provides for licensing Structural Engineers. This opposition cannot be accounted for by the fear that the architects license law will be repealed or destroyed, as has been claimed by them.

House Bill No. 406 in the form in which it has been approved by your Committee is as plain as the English language can make it, and we fail to see how it can possibly be interpreted to repeal or destroy the Architects Law. *It leaves to the architect every right or privilege which the profession of architecture should ask or that the people should grant to any profession.*

The architects are evidently opposing House Bill No. 406, simply *because it will destroy the monopoly now enjoyed by their profession.* Why should they have a monopoly in Illinois when engineers as well as architects are allowed to design and supervise buildings in nearly every other country and state in the civilized world?

The architectural profession is a very old one and when it was greatest it enjoyed no legal protection, but *this is the age of the engineer.* He has made possible the achievements of the 20th century, including the construction of buildings of unprecedented size which he is not allowed to design under his own name in Illinois.

The engineering profession comes before you not to seek a monopoly for themselves but only *equal rights before the law.* They ask this not only for their own sake but to promote the greatness and the welfare of the State of Illinois.

We are enclosing herewith some further reasons for asking your favorable consideration for this bill, and we are mailing you under separate cover some of our literature which explains our position fully. We trust that it will receive your careful attention and that we may be favored with your support.

Very respectfully,
LEGISLATIVE COMMITTEE OF THE
WESTERN SOCIETY OF ENGINEERS.

Reasons Why the Bill For Licensing Structural Engineers Should Become a Law.

1. It will provide for public safety in the construction of buildings and structures by requiring the designers and superintendents of such work to have a certain amount of experience and ability.

2. Its operation will be parallel to that of the existing Architects' License Law. It does not repeal that law nor does it interfere with the practice of architecture as it now exists.

3. It will give to the public the privilege of employing either an architect or engineer to design and supervise the construction of buildings. This right is now denied the public, for the existing law permits only licensed Architects to design and supervise the construction of buildings.

4. The licensed architect will be exempt from the provisions of the structural engineers' law and the structural engineer will be exempt from the provisions of the architects' law, so that it will not be necessary for a practitioner to have both licenses.

5. Practically every Civil Engineer practicing in Illinois is now violating the statutes of the State because of the broad definition of buildings contained in the Architects' License Law. That definition is "The term building in this Act shall be understood to be a structure consisting of foundations, walls and roof with or without other parts." This covers tunnels, manholes, etc., as well as all buildings of whatever character in connection with engineering projects. To be outside the pale of the law (even though not rigidly enforced) is intolerable to the members of this profession.

6. Civil Engineers specializing in Structural Engineering cannot legally practice their profession in connection with the construction of buildings, but must serve as employes of Architects. The proposed law removes this disability.

7. The existing law will not be repealed by the proposed law as it has been introduced (an early draft of the bill which was widely circulated might have had that effect). Nor will the rights and privileges of those holding Architects' license be abridged in any way, but the monopoly now held by them will be broken in so far as clients see fit to employ engineers.

8. Engineers will be allowed to associate with Architects in the form of co-partnership or corporation, a most desirable ar-

rangement for modern building construction, but which is now forbidden by statute.

9. The proposed law has been drafted by the Legislative Committee of the Western Society of Engineers under the direction of its Board of Direction. It has been approved by a referendum of the Society in which more than 90 per cent of the replies were affirmative.

10. A canvass of the Structural Engineers of the State indicates that the fees collected will be sufficient to pay the cost of administration of the law, so there will be no burden imposed on the State.

**An Act to Provide For the Licensing of Structural Engineers,
To Regulate the practice of Structural Engineering,
And to Exempt Licensed Structural Engineers
From the Provisions of the Act Relating
to the Practice of Architecture.**

SECTION 1. Be it enacted by the People of the State of Illinois, represented in the General Assembly. That within thirty days after the taking effect of this Act the Governor of the State shall appoint a State Board of Examiners of Structural Engineers, to be composed of five members, one of whom shall be a Professor in the Civil Engineering Department of the University of Illinois, and the others shall be structural engineers of recognized standing, who have had not less than ten years practical experience, then practicing as structural engineers in the State of Illinois, to hold, regulate, supervise and control examinations of applicants for license to practice structural engineering in this State. Two of the members shall be designated to hold office until January 31, 1917, and the other three shall hold office until January 31, 1919; and thereafter upon the expiration of the term of office of the persons so appointed, the Government of the State shall appoint a successor to each person whose term of office shall expire, to hold office for four years, and said person so appointed shall have the above specified qualifications. In case appointment of a successor is not made before the expiration of the term of any member, such member shall hold office until his successor is appointed and duly qualified. Any vacancy occurring in the mem-

bership of the Board shall be filled by the Governor of the State for the unexpired term of such membership.

2. The members of the State Board of Examiners of Structural Engineers shall, before entering upon the discharge of their duties, make and file with the Secretary of State the constitutional oath of office. They shall, as soon as organized, and biennially thereafter in the month of February elect from their number a President and a Secretary who shall also be the Treasurer. The Treasurer, before entering upon his duties, shall file a bond with the Secretary of State, for such a sum as shall be required of him by the Secretary of State, and in such form and with such sureties as may be approved by the Governor of the State. The Board shall adopt rules and regulations not inconsistent with this Act to govern its proceedings; shall adopt a seal; and shall cause the prosecution of all persons violating any of the provisions of this Act, and may incur necessary expense in that behalf. The Secretary shall have the care and custody of the seal; and shall keep a record of all the proceedings of the Board which shall be open at all times to the public.

The Secretary of the Board shall receive a salary to be fixed by the Board, and which shall not exceed the sum of Fifteen Hundred (\$1,500.00) Dollars per annum; he shall also receive his traveling and other expenses incurred in the performance of his official duties, and each of the other members of the Board shall receive the sum of Ten (\$10.00) Dollars for each day actually engaged in the performance of his duties, and all legitimate and necessary expenses incurred in attending the meetings of the Board and in conducting examinations, which together with all other lawful expenses shall be paid from funds appropriated therefor, as provided by law.

3. Three members of the Board shall constitute a quorum. Meetings of the Board shall be called by the Secretary upon the written request of the President or any two members, by giving at least seven days' written notice of such meetings to each member, counting from the day on which the notices are post-marked, telegraphed or personally delivered.

The Board shall adopt rules and regulations for the examination of applicants for license to practice Structural Engineering, in accordance with the provisions of this Act, and may amend, modify, and repeal such rules and regulations from time to time. The Board shall immediately upon the election of each officer

thereof, and upon the adoption, repeal or modification of its rules of government or its rules and regulations of examinations of applicants for licenses, file with the Secretary of State and publish at least twice in at least one Engineering Journal of general circulation in the State of Illinois and in one daily newspaper published in the State of Illinois, the name and address of each officer, and a copy of such rules and regulations, or the amendments, repeal or modification thereof.

4. Provisions shall be made by the Board hereby constituted for holding examinations at such place or places as shall be appointed by the Board, and at least two in each year, of applicants for license to practice structural engineering. Notice of the time and place of the holding of such examinations shall be published in the same manner as is hereinbefore provided for the publication of the rules and regulations pertaining to such examinations adopted by the Board, provided that the last day of such publication shall be at least twenty (20) days prior to the date of holding such examinations. Each applicant shall pay to the Secretary of the Board, in advance, a fee of Twenty (\$20) Dollars, and shall present his affidavit that he is of the age of twenty-one years, or above. Such examinations shall be held by the examiners as a body, a majority of whom shall constitute a quorum, or by a committee of two or more members selected and appointed by the Board. Examinations shall be conducted by written or printed interrogatories, in whole or in part.

Each applicant examined shall sustain a satisfactory examination in the design and construction of buildings and structures according to scientific principles and with special reference to strength and safety; the strength and properties of the various building materials; the principles of theoretical and applied mechanics; the ability of the applicant to apply his knowledge to the ordinary requirements of structural engineering; and in such other matters and subjects as the Board of Examiners may require as suitable to fairly and thoroughly test the competency of the applicant to practice structural engineering in this State.

Every applicant for a license, except those who apply by virtue of the provisions of Section Five (5) and Six (6) of this Act, shall present to the Board of Examiners satisfactory proof, by affidavit, or otherwise, as the Board may direct:

(a) That at the time of the taking effect of this Act, he was actually engaged in the practice of structural engineering in this

State, and did not apply for license under Section Five (5) of this Act, and in such case the applicant shall be entitled to an examination without regard to the number of years he has practiced. Or,

(b) That within ten years next prior to his application, he has practiced structural engineering in some state or territory of the United States, or in some foreign country, for not less than six years, during at least two full years of which period he shall have been in responsible charge of work, as principal or assistant.

Or,

(c) That within ten years next prior to his application, he has pursued a course of study and training in the theory and practice of structural engineering covering at least the subjects above specifically enumerated, for the period of not less than six years, in the employ or under the supervision, direction and tuition of one or more practicing structural engineers, during at least two full years of which period, every such applicant shall show that he has been in charge of work in designing or construction in the employ or under the direction of such engineer or engineers. Such applicants who have graduated from a college or school of engineering considered by the Board to be in good standing and requiring a course of study of not less than four years, during at least thirty weeks in each year, shall be credited two years upon the six-year period required above, the remaining four years to be pursued as hereinabove in this paragraph provided. The Board in its discretion may adopt rules providing for credit not exceeding two years on said six-year period to applicants who have pursued a course of instruction in schools or colleges of engineering approved by the Board, but who have not graduated.

If the result of the examination of any applicant shall be satisfactory to a majority of the Board, under its rules, the Secretary, upon an order of the Board, and upon payment by said applicant of the further sum of Thirty (\$30) Dollars, shall issue to said applicant a license to practice structural engineering in this State, in accordance with the provision of this Act, which license shall contain the full name, birthplace, and age of the licensee, and shall be signed by the President and Secretary and sealed with the seal of the Board.

All papers received by the Secretary in relation to applications for license, shall be kept on file in his office, and proper index and record thereof shall be kept by him.

Any fraudulent act or representation by any applicant in connection with his application for examination, or for a license without examination, under this Act, or during the conduct of his examination, shall be sufficient cause for the withholding of the license by the Board of Examiners or for its revocation after it has been issued.

5. Any person who shall by affidavit or other proof as the Board may direct, show to the satisfaction of the State Board of Examiners of Structural Engineers that he was a resident of and engaged in the practice of structural engineering in this State, on the date of the taking effect of this Act, shall be entitled to a license without examination, provided such application shall be made within six months after the taking effect of this Act. Such license, when granted, shall set forth the fact that the person to whom the same was issued was practicing structural engineering in this State at the time of the taking effect of this Act and is therefore entitled to the license to practice the profession of structural engineering without an examination by the Board of Examiners, and the Secretary of the Board shall upon the payment to him by the applicant of a fee of Fifty (\$50) Dollars issue to the person named in said affidavit a license to practice structural engineering in this State in accordance with the provisions of this Act.

6. The State Board of Examiners may in its discretion, issue a license, without examination, upon payment of a fee of Fifty (\$50) Dollars, to a structural engineer licensed under the laws of any other State or Territory of the United States, or any foreign country, provided it appear to the Board that in the State or Territory or Country in which such license was issued, the requirements for a license to practice structural engineering were equal to those prescribed in this State, and that such State, Territory or Country accord a like privilege to structural engineers who hold licenses issued under the provisions of this Act.

7. Every person holding a license to practice structural engineering in this State shall have it recorded in the office of the Secretary of State and the date of recording shall be endorsed thereon, and upon such recording said license shall be of force and effect throughout the State. The Secretary of State shall be entitled to receive a fee of \$1.00 for the recording of each license filed for record. Until such license is recorded as herein pro-

vided, the holder thereof shall not exercise any of the rights or privileges conferred therein and thereby.

8. Every licensed structural engineer shall have a seal, the impression of which must contain the name of the Structural Engineer, his place of business, and the words, "Licensed Structural Engineer," "State of Illinois," with which he shall stamp all plans, drawings and specifications issued by him for use in this State.

9. Persons licensed to practice structural engineering in this State under this Act shall be exempt from the provisions of "An Act to provide for the licensing of architects and regulating the practice of architecture as a profession," approved June 3, 1897, and in force July 1, 1897, and all amendments thereto.

10. No corporation shall be licensed to practice structural engineering, but it shall be lawful for corporations to furnish to others engineering plans, drawings and specifications for or engineering supervision of the construction of buildings and structures within the meaning of this act, provided such plans, drawings and specifications have been prepared by a structural engineer or engineers licensed under this act and bear the seal of such engineer, and provided that such supervision shall be rendered by a structural engineer or engineers licensed under this act, and provided further, that the chief executive officer or managing agent of such corporation in the State of Illinois shall be a structural engineer licensed under this act.

11. It shall be lawful for one or more licensed structural engineers to enter into copartnership with one or more architects licensed under the laws of this State, for the practice of their professions.

12. Any person who shall be engaged in the designing, or supervision of the construction, enlargement or alteration of buildings and structures, as hereinafter defined, or any part thereof, for others and to be constructed by persons other than himself shall be regarded as practicing structural engineering within the meaning of this Act and shall be held to comply with the same.

Buildings and structures within the meaning of this Act shall be construed to mean buildings and structures having as essential structural features, foundations, columns, girders, trusses, arches and beams, or some of them, and in which safe design and construction require that loads and stresses must be computed and

the sizes and strength of parts must be determined by mathematical calculations based on scientific principles and engineering data. Provided, however, this act shall not be regarded as applying to: (a) Draughtsmen, students, clerks of work, superintendents and other employes of structural engineers duly licensed to practice under this Act, so long as they work and act under the instructions, control, direction and supervision of their employers; (b) Superintendents of construction of buildings and structures employed and paid by the owners, provided such superintendents act under the control, direction and supervision of a structural engineer, duly licensed under this Act; (c) Persons licensed to practice architecture in this State; and provided further nothing contained in this act shall be construed to prevent any person, mechanic or builder from making plans and specifications for, or supervising the construction, enlargement or alteration of any building or structure that is to be constructed by himself or his employes.

13. After six months from the taking effect of this Act, it shall be unlawful for any person to practice structural engineering without a license in this State, or to advertise, or to display a sign or card, or other device which indicates or represents that he is entitled to practice as a structural engineer in this State, and any person guilty of the violation of any of the provisions of this Act shall be punished by a fine of not less than Ten (\$10) Dollars nor more than Two Hundred (\$200) Dollars, for each and every offense.

14. It shall be lawful and be the duty of the State Building Commissioner appointed and acting under any State Building Code which is now or which may hereafter be in force and effect in this State, or of any Building Commissioner of any city, town or village organized under any general or special law of this State, which has adopted a building code or other ordinance or laws relative to the construction, alteration, repair, maintenance and safety of buildings and structures, and providing for the issuing of building permits by a Building Commissioner or other officer designated for that purpose, to issue permits for the construction, enlargement or alteration of such buildings or structures to any owner, or his agent, upon the filing with the State Building Commissioner or with the Building Commissioner of such city, town or village, of a true copy of the plans, drawings and specifications for the construction, enlargement or alteration

of such buildings or structures, and a certificate signed by the structural engineer who executed them certifying under his seal that said plans, drawings and specifications are in accordance with the State Building Code, or the Building Code of such city, town or village, as the case may be, provided, such structural engineer shall be licensed under this act, and provided, such owner or his agent has complied with all other requirements of law requisite to obtain such building permit, and provided, further, that such plans, drawings and specifications are in accordance with the State Building Code, or the Building Code of such city, town or village, as the case may be.

15. Every licensed structural engineer in this State, who desires to continue the practice of his profession, shall annually, during the time he shall continue in such practice, pay to the Secretary of the Board during the month of July, a fee of Ten (\$10) Dollars, and the Secretary shall thereupon issue to such licensed structural engineer a certificate of renewal of his license for the term of one year. Failure by any licensed structural engineer in actual practice to cause his license to be renewed during the month of July in each and every year, shall constitute valid grounds for the revocation of his license. The failure to renew such license in apt time shall not deprive such structural engineer of the right of renewal thereafter; but the fee to be paid upon the renewal of a licence after the month of July shall be Fifteen (\$15) Dollars.

It shall be the duty of the Secretary of the Board to file with the Secretary of State on the 15th days of February and August in each year certified lists of all licenses then in force, upon the filing of each of which said lists, the Secretary of State shall be entitled to receive a fee of \$1.00.

16. Licenses issued in accordance with the provisions of this Act shall remain in full force unless revoked for cause, as hereinafter provided. Any license so granted may be revoked by a four-fifths vote of the State Board of Examiners for gross incompetency; or recklessness in the construction of buildings or other structures; or for fraudulently affixing his seal to plans, drawings or specifications; or for any dishonest practice or practices on the part of the holder thereof; or for fraud in obtaining his license; or practicing without payment of the annual license renewal fee provided in Section Fifteen (15) of this Act; but before any license shall be revoked such holder shall be entitled

to at least twenty days' notice of the charge against him, and of the time and place of the meeting of the Board for the hearing and determining of such charge.

For the purpose of carrying out the provisions of this Act relating to the revocation of licenses, the Board, and each member thereof, shall have the power to administer oaths, and said Board shall have the power to administer oaths, and said Board shall have the power to secure by its subpoena both the attendance and the testimony of witnesses, and the production of books and papers, relevant to any investigation by the Board for the purpose of carrying out the provisions of this Act, relating to the revocation of licenses. Witnesses shall be entitled to the same fees and mileage as witnesses in a Court of Record, to be paid in like manner. The accused shall be entitled to the subpoena of the Board for his witnesses, and to be heard in person or by counsel in open public trial. Any Circuit Court of this State or any judge thereof, either in term time or vacation, upon application of such Board, may in its discretion by order duly entered by such court or judge thereof, require the attendance of witnesses, the production of books and papers, and giving of testimony before such Board, and upon refusal or neglect to so appear and testify and produce such books and papers as commanded by such order of the court or judge thereof, may compel, by attachment or otherwise, as provided by law, the attendance of such witnesses, the production of such books, and papers and the giving of testimony before such Board, in the same manner as production of evidence may be compelled before said court. Every person who, having taken an oath or made affirmation before said Board, shall wilfully swear or affirm falsely, shall be guilty of perjury and upon conviction shall be punished accordingly. It shall be the duty of the Secretary of the Board to promptly give notice of all revocations of licenses to the Secretary of the Board to promptly give notice of all revocations of licenses to the Secretary of State who shall make an entry thereof in his records.

17. The State Board of Examiners shall have power to entertain and grant for good cause shown, petitions to vacate its orders revoking licenses and reinstate such petitioner to practice in this State, and to adopt rules and regulations governing the requirement and hearing of such petitions provided that at least one year shall intervene between the date of the entry of the order revoking a license and the filing of such petition in cases

involving gross incompetency, recklessness, dishonest practices, or fraud. The Board in its discretion may require petitioners whose licenses have been revoked for gross incompetency or recklessness to submit to an examination by the Board touching their professional qualifications and competency to practice, which shall at least cover the subjects required of applicants for a license by examination. Such petitions shall briefly state the date and cause of revocation, the grounds upon which petitioner seeks reinstatement, and such other facts as the Board by its rules may prescribe, and shall be verified by the petitioner. The Board in the hearing of such petitions shall, as near as may be, follow the practice required by this Act in relation to citations to revoke licenses. Any person interested may appear and contest such petitions. A majority vote of the Board shall be sufficient to reinstate such petitioners to practice.

Every petitioner shall pay to the Secretary of the Board, in advance, upon the filing of his petition, a fee of Ten (\$10) Dollars.

It shall be the duty of the Secretary of the Board to promptly notify the Secretary of State of the reinstatement of any such applicant, and the Secretary of State shall note the same on his records accordingly.

18. It shall be the duty of the Secretary of the Examining Board to file at the close of each fiscal year with the Auditor of Public Accounts of the State of Illinois, a full annual report of the proceedings of the Board, including a statement of all funds received and disbursed, and he shall also pay over to the State Treasurer of the State of Illinois, quarterly, all license fees and renewal and other fees collected by him during the preceding quarter and take his receipt therefor. Said report shall be attested by the affidavits of the President and Secretary.

19. All acts or parts of acts inconsistent herewith are hereby repealed.

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

ASSOCIATION OF ENGINEERING SOCIETIES

BALANCE SHEET, DECEMBER 31, 1914

ASSETS.

Cash in bank.....	\$ 959.74
Due from Societies—	
Louisiana Engineering Society.....\$300.00*	
Oregon Society of Engineers..... 25.83*	
	<hr/>
	325.83
Due from advertisers.....	78.75
	<hr/>
	\$1,355.32

LIABILITIES.

Printer	\$ 172.51
Salary of Secretary (Dec.).....	75.00
Commission on advertising receipts.....	13.45
Prepaid 1915 subscriptions.....	84.15
	<hr/>
	\$ 345.11
Surplus	\$1,010.21
	<hr/>
	\$1,355.32

JOSEPH W. PETERS, *Secretary.*

*Paid in Jan. and Feb., 1915.

ASSOCIATION OF ENGINEERING SOCIETIES

Vol. 54.

JANUARY 1915.

No. 1

PROCEEDINGS.

Montana Society of Engineers

Butte, Montana, Nov. 9th, 1914.

The regular meeting of this Society was held at the usual time and place, with Ex-President B. H. Dunshee in the chair. President Sales arrived later in the evening. Members present: Messrs. Goodale, Kyd, Moore, Munroe, Dunshee, Sales, Cochrane, Simons. The minutes of the last meeting were approved as read. The secretary presented a request from the American Road Builders' Association to be held in Chicago, Ill., Dec. 14-18, 1914, for delegates for said convention, and the chair appointed the following committee: H. L. Miller, F. W. Blackford, J. H. Ellison. The Secretary announced the death of another member of the Society, F. Augustus Heinze, and the chair selected the following committee to prepare a sketch of his life for publication in the Journal of the Society: E. H. Wilson, A. E. Hobart, Frank M. Smith. In the absence of the author, Mr. John C. Beebe, C. E., the Secretary read Mr. Beebe's paper entitled, "Water Power and Its Connection With Irrigation in Southern Idaho." The thesis brought forth much favorable comment and a unanimous vote to have it published in the Journal of the Association.

Adjournment.

CLINTON H. MOORE, *Secretary*.

Butte, Montana, Dec. 14, 1914.

The December meeting of the Society was called to order at the usual time by President R. H. Sales, a quorum being present. The minutes of the last meeting were approved as read. The resignations of J. Scott Harrison, IV., and Chas. H. Davis were read and accepted. The committee on resolutions relative to the death of F. Aug. Heinze failed to report and were given further time. The secretary reported the death of Aug. Christian, a former Vice-President of the Society, and the following committee was appointed by the chair to prepare a sketch of his

life for publication in the Journal of the Association: Messrs. Gillie, Simons and Moulthrop. The chair appointed the following committee on nomination of officers for the coming year: Messrs. Dunshee, Bowman and Bacorn. The President gave a very entertaining account of a recent trip to Alaska, after which adjournment followed.

CLINTON H. MOORE, *Secretary*.

Oregon Society of Engineers

Regular monthly meeting of the Oregon Society of Engineers in Room "A" of the Public Library Building, December 10, 1914.

The meeting was called to order by President Graves, who called for the reading of the minutes of the previous meeting, which were approved without change.

Prof. O. F. Stafford was then introduced, and spoke on "Western Hydro-Electrical Power and the Electric Chemical Industries."

He outlined the various uses to which electric power in large quantities can be put, and told of the various places in the world where power is now developed in large quantities at low rates. Then he explained why certain of the electric chemical industries could not be profitably operated in the vicinity of Portland, and of others that might compete to advantage with similar industries in other parts of the world.

The lecture was followed by a discussion in which Messrs. Broili, Graves, Colby, Thompson and Gilbert took part.

The Secretary read a letter from Mr. Stocker, replying to the talk by Mr. C. E. Warner, regarding the Los Angeles Aqueduct.

Mr. Cunningham said that it was his opinion that Mr. Warner had not been quite fair in his presentation of the subject at the meeting of October 8th.

Upon motion, the Society adjourned.

ORRIN E. STANLEY, *Secretary*.

Special meeting of the Oregon Society of Engineers in Room "B" of the Public Library, November 12, 1914.

The meeting was called to order by President Graves, who called upon Mr. C. F. Blake, Chairman of the Library Committee to state the object of the meeting.

Mr. Blake gave a brief history of the work of the committee since the organization of the society, stating that the Technical section of the Library had been indexed, and the index made available to the public, and now it remains for the society to help the librarians to get the index and the books properly used by the engineers of the city.

Mr. Graves then spoke of the education of engineers in general, and was followed by Messrs. C. E. Condit, Noble and Blake.

Miss Isom, Librarian, spoke of the young men in the shops who

might be induced to use the library to help themselves in their work, if they but knew what the library has for them.

Mr. Brewster, member of the Library Board, asked if it was the intention to parallel the work of the school of trades or the Y. M. C. A., and was assured by Mr. Blake that the work as outlined would not interfere with any that is now being carried on in the city.

Messrs. Graves, Blake, Strayer and Stanley spoke briefly of what might be done by the Society in connection with the Library, as viewed from their respective standpoints, and as there was not a quorum present, the meeting adjourned without definite action.

ORRIN E. STANLEY, *Secretary*.

Civil Engineers' Society of St. Paul

St. Paul, Minnesota, November 9, 1914.

The regular monthly meeting of the Civil Engineers' Society of St. Paul was called to order by President Toltz, in the Court Room No. 5, in the City Hall, at 8:20 p. m., November 9th.

There were 12 members and 8 guests (4 of whom were ladies prominent in civic affairs) present.

Minutes of the May 11th and October 12th meetings were read and approved.

Moved, seconded and unanimously carried that Article 24 of the Constitution of this Society be amended by adding thereto the following:

"A member of any Engineering Society with whom we have exchange privileges may become a member of this Society on the same basis, provided that the other Society will reciprocate."

Moved, seconded and unanimously carried that the amendment to Section 1, of Article V, of the Articles of the Association of Engineering Societies, as proposed in letter of August 12, 1914, from the Association of Engineering Societies, be ratified by this Society, the amended section to read as follows:

ARTICLE V.

Section 1. Any society of Engineers, or other technical organization, may become a member of this Association upon the adoption of these Articles by a majority vote of said society and the approval of such affiliation by a majority of the Board of Managers."

Moved, seconded and carried, that the recommendation of the Secretary to purchase an Addressograph for the Society be referred to a committee to investigate both the Addressograph and a printing and addressing machine described by President Toltz. President Toltz appointed to the committee: E. J. Dugan, Geo. W. Rathjens and Geo. H. Herrold.

Moved, seconded and carried, that President Toltz appear before the Board of Regents of the University of Minnesota to urge on behalf of

this Society that their efforts be made to obtain this year from the State Legislature the proposed new building for the Electrical Engineering Department.

Professor Frederick Bass, of the University of Minnesota, gave an illustrated talk on "Refuse Collection and Disposal."

Motion to adjourn seconded and carried at 10:00 p. m.

EDWARD J. DUGAN, *Secretary*.

St. Paul, Minnesota, December 14, 1914.

The regular monthly meeting of the Civil Engineers' Society of St. Paul, Minn., was called to order by President Toltz, in Room 7, Old Capitol Building, at 8:20 p. m., December 14, 1914. There were 14 members present.

Minutes of the last regular meeting were read and approved.

Moved, seconded and carried, that in response to offer made in their letter of November 30th, this Society send the 1914 Volume of the Journal of the Association of Engineering Societies to the North Dakota Society of Engineers in exchange for their Proceedings, Volume I, just published.

Moved, seconded and carried, that a letter dated November 19, 1914, from the American Association for the Adoption of the Metric System, in which, indorsement of the movement to adopt the Metric System universally, was requested, be referred to a committee of three to be appointed by President Toltz, for consideration and for recommendation of proper action to be taken by this Society in the matter. President Toltz appointed to the committee the following: H. Le Roy Brink, chairman; James, E. Carroll, W. E. King.

Remarks by H. Le Roy Brink, Treasurer, in criticism of the present financial system of the Society relating to the present method of handling funds and accounts by the Treasurer.

Moved, seconded and carried, that the Auditing Committee and the Treasurer formulate an adequate financial system for the Society and present same at the next regular meeting of the Society.

Remarks on letter of November 12th, from the Campaign Committee for the United Charities of St. Paul, it being the opinion of members present that as most of them had already contributed to the proposed \$60,000 fund, either directly as individuals, or indirectly in some other way, also that as on this date the whole amount of the fund had been raised, that the Society as such would not at this time contribute to the fund, but should there any special needs arise later, this Society would be glad to appropriate Society funds in reasonable amount to help others in making up such special fund as might be required. In order to show the indorsement of the proposed work by this Society, the following resolution was adopted:

Whereas: The United Charities is an organization whose aim is to carry on a constructive campaign to remove the causes of poverty and alleviate suffering caused by it,

Therefore, Be It Resolved: that the Civil Engineers' So-

ciety of St. Paul, Minn., hereby heartily endorses the efforts being made to raise \$60,000 to finance the United Charities for two years and recommends to the public that whole-hearted support, both financial and moral, be given to the United Charities.

Moved, seconded and carried unanimously that the proposed amendment to Article 24 of the Constitution, adopted unanimously at the meeting, November 9th, be hereby adopted, as follows: By adding to Article 24.

"A member of any Engineering Society with whom we have exchange privileges may become a member of this Society on the same basis, provided that the other Society will reciprocate."

Moved, seconded and carried, that the following applicant be elected to Full Membership in this Society, the application having been approved by the Examining Board.

Clarence H. Stewart, 2151 Commonwealth Ave., St. Paul.

Moved, seconded and carried, that the membership applications of George E. Hanson, Dunn Center, North Dakota, and Elmer L. Nye, State Highway Commission, St. Paul, be returned to the Membership Committee for further information, and to be handed by the Membership Committee to the Examining Board.

Secretary instructed by the President to notify the Auditing Committee to have their report on the Treasurer's accounts for 1913 ready to present at the next meeting, January 11th.

J. L. Mowry, Assistant Engineer, Department of Agriculture, University of Minnesota, gave a lecture on "The Genesis of the Traction Engine."

The Society discussed the paper and tendered a vote of thanks.

Motion to adjourn, seconded and carried at 10.00 p. m.

EDWARD J. DUGAN, *Secretary*.

The Engineers' Club of St. Louis

The 790th meeting of the Club was held in the Club Rooms, Wednesday, December 2, 1914, at 8:15 p. m., as the Annual Business Meeting. President A. P. Greensfelder presided. The total attendance was 75.

The minutes of the 789th meeting of the Club were read and approved.

The minutes of the 559th meeting of the Executive Committee were read.

The minutes of the third meeting of the Joint Council of the Associated Engineering Societies of St. Louis were read.

The minutes of the first meeting of the Board of Trustees of the Building Fund of The Engineers' Club of St. Louis were read.

The presiding officer called for the reading of the proposed agreement for co-operation of The Engineers' Club of St. Louis with allied technical organizations in Missouri, as follows:

1. The Engineers' Club extends its privileges to members of these organizations when visiting St. Louis.

2. The Engineers' Club to invite these organizations to participate in its Annual Banquet.

3. The Engineers' Club offers to exchange speakers on subjects of mutual interest from time to time, as requested or desired.

4. The Engineers' Club waives its initiation fee to members of these organizations who desire to join.

5. The Engineers' Club recognizes the influence and activities of these organizations by a reduction of One Dollar in the annual dues of its non-resident members who join these organizations.

6. The Engineers' Club to print in its Year Book a list of the officers and members of these organizations.

7. The Engineers' Club to offer for publication in the Journal of the Association of Engineering Societies the available papers and discussion presented at meeting of these organizations.

8. The Engineers' Club offers all its publication to members of these organizations at the same terms as to its own members.

9. The Engineers' Club to consider this agreement as of effect when adopted or revised by its members and accepted by the allied organizations.

Accepted by The Engineers' Club of Jefferson City, November 7, 1914.

Accepted by The Engineers' Club of Springfield, November 21, 1914.

Motion made, seconded and unanimously carried that the agreement for co-operation of The Engineers' Club of St. Louis with allied technical organizations in Missouri as read be approved.

The presiding officer called for the reading of the proposed agreement of The Engineers' Club of St. Louis with students' technical societies in Missouri, as follows:

To stimulate interest in technical meetings and to encourage students of engineering to identify themselves with organizations of a professional nature, The Engineers' Club of St. Louis makes the following offer to students' technical societies at universities in Missouri, the same to go into effect when adopted or revised by its members and ratified by the student societies concerned with the approval of their respective faculties:

1. The Engineers' Club offers annually in each educational institution participating in this agreement a free Junior Membership, carrying with it remission of initiation fee and dues for one year, to that student who shall present the best paper before the technical society of which he is a member. In case there is more than one technical society in each of the participating institutions, each of such societies shall nominate a candidate for the prize, and the final selection of the candidate from the institution shall be made by a committee consisting of the

Dean of the department and a duly elected representative of each society.

2. The Engineers' Club agrees to invite the members of student technical societies to join excursions given under Club auspices, when such an invitation can be issued without embarrassment to possible hosts of the Club.

3. The Engineers' Club offers to suggest speakers who might be willing to address student societies.

4. The Engineers' Club offers to print in its May or June Bulletin the names of members of students societies who desire to secure summer employment.

5. The Engineers' Club offers to print in its Year Book a list of the student societies and the names of their officers.

6. The Engineers' Club offers to members of student societies the privilege of Junior Membership at one-half of the usual rates for initiation fee and annual dues.

7. The Engineers' Club offers to participate annually in one joint meeting arranged by a student society, or group of societies.

8. The Engineers' Club offers the facilities of its Library to members of student societies in exchange for a similar privilege to its own members in available university libraries, with the understanding that these mutual exchange privileges shall in all cases be governed by existing library rules of all the parties concerned.

9. The Engineers' Club authorizes its Executive Committee to make an appropriation from time to time (annually if the finances of the Club will permit) for assisting in the prosecution of an original research by a member of a student society, provided the recipient of such financial assistance shall have the endorsement of the faculty of the institution with which he is connected (as certified by the Dean of the faculty) and the approval of the Executive Committee of the Club. In such cases the Club reserves the right to the exclusive publication of the results of the investigation in its own Journal or Proceedings.

Motion made, seconded and unanimously carried that the agreement of The Engineers' Club of St. Louis with students' technical societies at Universities in Missouri as read be approved.

The presiding officer called for the reading of the proposed amendment to the Constitution, as follows:

Amend Article II, Section 1, by inserting the words *Senior Members* in the second line after "Honorary Members."

The amended section will then read as follows:

Section 1. The membership of the Club shall be divided into the following classes: Members, Honorary Members, Senior Members, Associate Members and Juniors.

Further amend Article II by adding another section to be known as *Section 4*, and change the numbering of sections 4, 5 and 6, to 5, 6 and 7.

The new section to read as follows:

Sec. 4. A Senior Member shall be a person not less than sixty-five years of age who has been a member of the Club for not less than twenty-five years, and shall be elected by unanimous vote of the Executive Committee, all members of the Committee voting thereon. Senior members shall be subject to no fees or assessments of any kind.

Motion made, seconded and unanimously carried that the amendment to the Constitution as read be approved at this meeting and referred to a letter ballot.

The presiding officer called for the reading of the proposed amendment of Sec. 12 of the By-laws, as follows:

Sec. 12. Dues—The initiation fee for Members shall be \$6.00; for Associate Members, \$5.00; for Junior Members, \$3.00, with an additional \$3.00 payable upon promotion to another grade of membership. Resident Members shall be those whose residence or place of business is within twenty miles of the Club Quarters. Dues shall be assessed by the Executive Committee in January for the current year, but shall not exceed \$12.00 for Resident Members; \$10.00 for Resident Associate Members; \$6.00 for Non-resident Members; \$5.00 for Non-resident Associate Members; \$6.00 for Resident Junior Members, and \$3.00 for Non-resident Junior Members. Dues of new members shall be computed from the beginning of the month following their election. Dues shall be payable semi-annually in advance during January and July, or annually in advance during January, at the option of the member. An accounting fee of twenty-five cents per month shall be charged on all delinquent dues. Any agreement in relation to dues entered into by the Club with any associated or co-operating society or societies shall be considered effective when adopted by a two-thirds vote of those voting at any meeting when the agreement is contained in the call for that meeting. Assessments for special purposes may be made upon recommendation of the Executive Committee by a two-thirds vote of members present at any meeting when the recommendation is contained in the call for such meeting, provided the total amount thus assessed in any calendar year shall not exceed one-half the annual dues allowable for each grade.

Motion made, seconded and unanimously carried that the amendment to the By-laws as read be adopted.

In accordance with Section 12 of the By-laws the following additional nominations were presented for the Board of Managers of the Association of Engineering Societies: Edward E. Wall, F. G. Jonah and W. W. Horner. The request was signed by J. A. Ockerson, G. M. Curry, B. H. Colby, J. T. Dodds and S. B. Russell.

The presiding officer called for the reading of the recommendation of the Executive Committee, as follows:

The Committee unanimously recommend that the Entertainment Fund be abolished and if their recommendation be concurred in by the Club that \$500.00 of said Fund be assigned to the Trustees of the Building Fund as one-half of the amount appropriated by the Club; that the residue of said Fund be transferred to the General Fund.

The presiding officer called for the question. Motion made and seconded that the ruling of the Chair was out of order. The motion was lost.

Motion made, seconded and carried that the recommendation of the Executive Committee be laid on the table.

The Assistant Secretary read a letter addressed to the President from Mr. H. C. Toensfeldt declining the use of his name as a nominee for the office of second vice-president.

The presiding officer accordingly ordered that the name of Mr. H. C. Toensfeldt be omitted from the ballot.

Upon objection the name of R. T. Toensfeldt was ordered omitted as a nominee for the office of secretary owing to the fact that he had not as yet been elected to full membership in the Club.

The presiding officer called for the annual reports of the officers and chairmen of committees. The following officers and committees, in the order stated, submitted reports and recommendations, all of which were unanimously accepted by the Club:

Treasurer.

Secretary.

President, for the Executive Committee.

Board of Managers, Association of Engineering Societies.

Joint Council, Associated Engineering Societies of St. Louis.

Meetings and Papers Committee.

Membership Committee.

Board of Trustees of the Building Fund.

Entertainment Committee.

Library Committee.

House Committee.

New Quarters Committee.

Quantity Surveying Committee.

Finance Committee.

By unanimous consent the report of the Quantity Surveying Committee was ordered published in the Journal and to be made a special order of business at a future meeting.

Motion made, seconded and unanimously carried that the use of a monthly and annual budget be continued.

Motion made, seconded and unanimously carried that the Club continue the plan of weekly meeting during the coming year.

Motion made, seconded and unanimously carried that the Club continue the publication of the monthly Bulletin during the coming year.

Motion made, seconded and unanimously carried that the recommendation of the Board of Trustees of the Building Fund suggesting that

the Year Book of the Club be their annual organ of publication be adopted.

In lieu of the failure of the Club to approve the recommendation of the Executive Committee to abolish the Entertainment Fund and transfer the funds to the Trustees of the Building Fund, Mr. J. A. Ockerson volunteered to be one of fifty members to donate \$10.00 towards making up \$500.00 to be paid into the Building Fund. Messrs. A. P. Greensfelder, Baxter L. Brown, J. W. Woermann, J. T. Dodds and E. L. Brown volunteered to follow Mr. Ockerson's example.

Motion made, seconded and unanimously carried that a rising vote of thanks be extended to the officers and chairmen of committees for their conscientious efforts in behalf of the Club.

Adjourned 11:15 p. m.

JOSEPH W. PETERS, *Assistant Secretary*.

The 791st meeting of the Club was held in the Club Rooms, Wednesday, December 9, 1914, at 8:15 p. m., as a Party Meeting with and under the auspices of the St. Louis Section of the American Institute of Electrical Engineers. The total attendance was 38.

Chairman S. N. Clarkson of the St. Louis Section of the A. I. E. E., presided.

The topic of the evening was the discussion of the New Standardization Rules of the A. I. E. E.

A light lunch was served after the meeting.

Adjourned 11:00.

JOSEPH W. PETERS, *Assistant Secretary*.

The 792nd meeting of the Club was held as a Joint Meeting of the Associated Engineering Societies of St. Louis under the auspices of The Engineers' Club of St. Louis for a trip of inspection through the plant of the Busch-Sulzer Bros. Diesel Engine Co. The total attendance was 150.

The party started at 1:30 o'clock in Eighth street, between Pine and Chestnut streets, in two special street cars, arriving at the plant about 2 o'clock.

Mr. Max Rotter, Chief Engineer of the Plant and Mr. C. G. Cox, Sales Manager, both members of The Engineers' Club, took the party in charge. After a very interesting trip through the plant, luncheon was served and the meeting adjourned about 4 o'clock.

JOSEPH W. PETERS, *Assistant Secretary*.

The 793rd meeting of the Club was held at the City Club, Wednesday, December 16, 1914, at 7 o'clock, as the Annual Dinner. The Associated Engineering Societies were invited to attend.

Officers elected for 1915 were announced by Assistant Secretary, J. W. Peters, as follows:

President	J. W. Woermann
First Vice-President.....	W. E. Rolfe
Second Vice-President.....	H. I. Finch
Secretary	S. W. Bowen
Treasurer	F. T. Cutts
Librarian	L. Chivvis
Directors	F. J. Bullivant and O. F. Harting

The programme of the evening consisted of an address by retiring President A. P. Greensfelder, the installation and address of President John W. Woermann, followed by addresses by Mr. Hunter McDonald, President Am. Soc. C. E., and Messrs. Paul W. Brown and Robert Hunt. Later, Mr. J. D. von Maur formally decorated retiring President Greensfelder with the "Royal Order of the Skids." There was a short minstrel act by two members of the Club and a general participation in song.

Adjourned 11:00.

JOSEPH W. PETERS, *Assistant Secretary.*

The 794th meeting of the Club was held in the Club Rooms, Wednesday, January 6, 1915, at 8:15 p. m., as a Joint Meeting of the Associated Engineering Societies under the auspices of The Engineers' Club of St. Louis. President John W. Woermann presided. The total attendance was 35.

President Woermann stated that one member of the Club had volunteered to be one of ten to subscribe \$1,000 to the Building Fund and that another member had volunteered to be one of twenty to subscribe \$500.

The committee appointed to audit and examine the books and accounts of retiring Treasurer Mr. W. E. Rolfe, for the fiscal year ending December 2, 1914, reported that they have examined said books and accounts and found them correct. The report is signed by Messrs. H. Spoehrer, Chairman; E. D. Smith and O. F. Harting.

The presiding officer presented Mr. Henry Wright, Landscape Architect, who delivered an illustrated talk on "The Economic Side of City Planning. Messrs. Julius Pitzman and J. H. Gundlach discussed phases of the subject.

A rising vote of thanks was tendered Mr Wright.

Adjourned 11:00 o'clock.

JOSEPH W. PETERS, *Assistant Secretary.*

ASSOCIATION OF ENGINEERING SOCIETIES

Vol. 54.

FEBRUARY, 1915.

No. 2

PROCEEDINGS.

The Oregon Society of Engineers

The annual meeting of the Oregon Society of Engineers was held at Manchester Hall, Portland, Ore., February 1, 1915, at 8:00 p. m. About 75 members and guests were present.

The meeting was called to order by President Graves, who announced the result of the election of officers as follows:

For President, W. S. Turner.

Third Vice-President, J. C. Stevens.

Secretary, Orrin E. Stanley.

Treasurer, Henry Morse and C. P. Keyser, tie vote. Mr. Morse was chosen by lot.

For Directors, P. L. Campbell, R. S. Edwards and James R. Thompson.

For Nominating Committee, W. H. Graves, Henry Blood, L. E. Hinman, Fred A. Ballin, J. André Fouilhoux, R. W. Jones, J. H. Morton and L. F. Harza.

The Secretary's report was then read, and the Secretary also read the Treasurer's report, as Mr. Blood was unable to be present.

Moved by Mr. Stevens that the President-elect appoint an Auditing Committee of three to look over the Treasurer's books and report at the next regular meeting. Carried.

After the President's address, which was the next order of business, the Electrical Engineers' Orchestra favored the meeting with a selection.

President-elect Turner was called upon for a speech and responded, as did also Mr. Stevens, the newly-elected Vice-President.

The following amendments to the Constitution were read by the Secretary, having been prepared by the By-laws Committee:

ARTICLE III—MEMBERSHIP.

Section 2—Classes. Strike out the word "*three*" and add the word "*four*"; also add the words "*Honorary Members*" before "*Active Members*" so that the section shall read, "There shall be four classes of membership—Honorary members, Active members, Junior members and Associates."

Section 3. Add another section to be designated as Section 3, as follows: *Honorary members* shall be men eminent

in some branch of engineering or science. They shall be entitled to all the privileges of the Society and shall be exempt from dues and assessments.

Change the numbers of Sections 3, 4, and 5 to 4, 5, and 6.

ARTICLE IV—ADMISSION TO MEMBERSHIP.

Strike out Sections 2, 3, 4 and 5 and substitute the following:

Section 2. Honorary members shall be elected by ballot upon the unanimous endorsement of the Executive Board. Five members of the Society may make recommendations for honorary membership. An affirmative vote of nine-tenths of the membership shall be necessary for election, which shall be declared void in case an acceptance is not received within four months after being notified by the Secretary.

Section 3. Not later than the 20th of January, April, July and October, the Secretary shall mail to each Active member of the Society a list of all candidates for admission or transfer, whose applications are on file in his office on the 15th of each of these months. This list shall contain the name, address and business of each candidate and such additional data, taken from his application, as will enable members to judge of his fitness for admission. A request for information which will help the Membership Committee to properly classify the applicants, shall accompany each list.

Section 4. Qualifications for membership of each applicant shall be thoroughly investigated by the Membership Committee and its findings reported to the Executive Board on or before the 20th of the month following the publication of the list.

Section 5. All applications submitted to it by the Membership Committee shall be acted upon by the Executive Board on or before the end of the month in which it receives the report of the Committee. Upon a favorable two-thirds vote by the Executive Board the name of the applicant shall be submitted by letter ballot to each active member of the Society.

Section 6. Ten per cent negative votes shall exclude a candidate from membership for a period of one year, at the expiration of which time the candidate may renew his application.

Section 7. Change number of Section 6 to 7.

ARTICLE V—EXPULSIONS.

Strike out Section 1 and substitute the following:

Section 1. Upon the written request of five members that for causes stated therein a member be expelled, the Executive Board shall consider the matter and if there appears to be sufficient reason shall notify the accused of the charges against him. He may present a written defense within one month of such notice. If no defense be made, or if the defense submitted be deemed not satisfactory, the accused shall be notified that he will be expelled unless within sixty days he elects to resign or appeal from the decision of the Board, such appeal to be submitted to the members of the Society by letter ballot. A majority of votes cast shall be necessary for expulsion.

ARTICLE VIII—DUES.

Strike out Section 3 and substitute the following:

Section 3—Annual Dues. The annual dues of members

of this Society, payable in two equal semi-annual installments on the first days of February and July, shall be as follows:

Active Members.....	\$5.00 per year
Junior Members	2.50 per year
Associates	5.00 per year

The dues of member of the Society residing permanently in other States or abroad, shall be one-half the dues specified above.

Mr. E. C. Hopson, chairman of a committee to consider legislation regarding the consolidation of the offices of State Engineer and State Highway Engineer reported, recommending the consolidation of the offices; that a board consisting of the President of the Senate, the Speaker of the House of Representatives, the President of the State University, the President of the Agricultural College, the President of the Oregon Society of Engineers, the President of the Portland, Oregon, Association of Members of the American Society of Civil Engineers and the Master of the State Grange, be recommended to name two or more candidates for the Governor to select the State Engineer from. A majority of votes in this board to be necessary for nomination.

The salary of the State Engineer was recommended to be \$5,000 per annum.

It was moved by Mr. Cantine that the report be adopted, and that the President-elect appoint a member to be present at Salem and urge the passage of such a law.

Mr. Newell, chairman of the Committee on Winter Employment reported that although the men whom he asked to help him in the preparation of his report had been idle for months, they had, without exception become so busy within fifteen minutes after leaving his office that they had not had time to get any facts of interest together in time for the meeting.

Mr. Henny, our only Past President, was called upon for a speech, and recounted some of the early history of the Society, and held out hopes for a bright future.

To further enliven the meeting at this time, President Graves read a letter from one O. U. Croesus, of New York, and elsewhere, charging that certain members of our Society were guilty of grave offenses, and unless the Society could either properly punish or expel them, the whole Northwest would suffer.

The "guilty men" were said to be Stanley, Stevens and Harza, and their separate and individual offences against the Society, the State and the Nation were related at length.

Upon motion of Mr. Crawford a committee was named to investigate the charges, and report back to the Society.

At this point, the meeting was turned over to Mr. J. E. Werlein, who, besides being a splendid entertainer himself, introduced many novel and delightful features, among which was a "raid" by a quartette of policemen, who, after creating considerable of a stir, sang several very beautiful selections.

Mr. Henkle, accompanied by his wife, gave an imitation of a "Little German Band," rendering the parts of the different instruments vocally in

a highly pleasing manner. He followed this by a vocal imitation of a cornet solo.

Mr. Charles E. Warner spoke of the Jovian Brotherhood of Engineers and Electricians.

Mrs. Hogan entertained us then, for some time with songs, stories and monologue in her beautiful Southern dialect.

A Dutch lunch was served, and was apparently very much enjoyed by all present.

Following the lunch was a two-round boxing match by two negro boys, who are in training to eat up any "white hope" that may come their way in about twenty years.

The meeting then adjourned.

ORRIN E. STANLEY, *Secretary*.

The Engineers' Club of St. Louis

The 795th meeting of the Club was held in the Club Rooms, Wednesday, January 13, 1915, at 8:15 p. m., as a Party Meeting with and under the auspices of the St. Louis Section of the American Institute of Electrical Engineers. Chairman S. N. Clarkson of the St. Louis Section of the A. I. E. E. presided. The total attendance was 45.

The paper of the evening was entitled "Graphical Recording Instruments as a Means of Increasing Efficiency," by Mr. J. W. Esterline of Indianapolis, Ind.

Discussion followed.

Adjourned 10:30 p. m. JOSEPH W. PETERS, *Assistant Secretary*.

The 796th meeting of the Club was held in the Club Rooms, Wednesday, January 20, 1915, at 8:15 p. m. President John W. Woermann presided. There were present 48 members and 14 guests.

The minutes of the 790th, 791st, 792nd, 793rd, 794th, and 795th meetings of the Club were read and approved.

The minutes of the 560th, 561st, 562nd and 563rd meetings of the Executive Committee were read.

The presiding officer then presented Mr. S. W. Bowen, Secretary of the Club, who delivered an illustrated talk on "The Design and Construction of the Reinforced Concrete Viaducts of Fort Worth, Texas." A discussion, participated in by quite a number of those present, followed. The Assistant Secretary read a written discussion submitted by Mr. C. E. Smith.

In accordance with a plan of the Publicity Committee, to provide discussion of timely topics of interest to the profession, the presiding officer

presented Messrs. W. E. Bryan and H. W. Eales, who delivered very interesting remarks on the cause and effect of the recent New York subway disaster. A brief discussion followed.

Adjourned 10:45 p. m.

JOSEPH W. PETERS, *Assistant Secretary*.

The 797th meeting of the Club was held in the Club Rooms, Wednesday, January 27, 1915, at 8:15 p. m. President John W. Woermann presided. There were present 35 members and 13 guests.

The minutes of the 796th meeting of the Club were read and approved.

Mr. J. T. Dodds, Chairman of the Quantity Surveying Committee, read a bill in reference to Quantity Surveying which it is proposed to have introduced in the Missouri State Legislature in the near future. The bill provides that all plans and specifications for public work in this State shall be accompanied by a bill giving the quantity of each kind of material to be used in the work.

Motion made, seconded and unanimously carried that the proposed bill receive the Club's endorsement and be referred to the Joint Council of the Associated Engineering Societies of St. Louis.

The presiding officer presented Mr. Charles M. Talbert, Director of Streets and Sewers of the City of St. Louis, who delivered a very interesting illustrated talk entitled "Traffic in the Down-town Streets To-day as compared with a Year Ago."

A discussion followed participated in by members and guests actively engaged in the administration and direction of the traffic problems of the city.

Adjourned 10:30 p. m.

JOSEPH W. PETERS, *Assistant Secretary*.

The 798th meeting of the Club was held in the Club Rooms, Wednesday, February 3, 1915, at 8:15 p. m. President John W. Woermann presided.

The minutes of the 797th meeting of the Club were read and approved as amended.

The presiding officer then presented Mr. Nelson Cunliff, Superintendent of Construction, Division of Parks and Recreation, City of St. Louis, who delivered an illustrated talk on "St. Louis Parks and Play Grounds." A brief discussion followed.

Adjourned 10:30 p. m.

JOSEPH W. PETERS, *Assistant Secretary*.

ASSOCIATION OF ENGINEERING SOCIETIES

Vol. 54.

MARCH, 1915.

No. 3

PROCEEDINGS.

The Montana Society of Engineers

Butte, Mont., January 11, 1915.

The January meeting was called to order by President Sales. A good audience was present. Minutes read and approved. The application of Leon De Vere Conkling was read and approved and ballot ordered. Messrs. George A. Paskard and Thomas E. Mitchell were placed on the corresponding membership list. All committee reports were deferred till the February meeting. Prof. D. C. Bard, of the State School of Mines, read a paper having as a subject the "Geology of Oil and Gas," with particular reference to Montana. He was followed by President Reno H. Sales, having for his subject "The Technology of Oil." The two papers brought forth a very interesting discussion. There being no further business, the society adjourned.

CLINTON H. MOORE, *Secretary*.

Butte, Montana, February 8, 1915.

The regular monthly meeting of the Society was called to order by President Reno H. Sales with a quorum present. Minutes of last meeting approved. Leon De Vere Conkling was elected to active membership. The report of the Committee on Nomination of Officers for the coming year presented the following list, which was approved:

M. H. Gerry, Jr., Helena, President.

A. W. Richter, Bozeman, First Vice-President.

J. H. Kyd, Butte, Second Vice-President.

Clinton H. Moore, Butte, Secretary and Librarian.

Samuel Barker, Jr., Butte, Treasurer and Member of Board of Managers of Association of Engineering Societies.

Frank T. Donahoe, Butte, Trustee for Three Years.

The committee to consider the place of holding the next annual meeting reported unanimously in favor of Butte. The report of the committee was adopted. Eight members of the Society were suspended for non-payment of dues. The dues of one member were remitted and his resignation was accepted. On motion, an exchange of library and society

room privileges with the Detroit Engineering Society was approved. Mr. D. C. Bard was appointed by the chair to take the place of Mr. E. H. Wilson on committee to prepare a sketch of the late F. Aug. Heinze, a member of this Society.

The committee appointed to prepare a biographical sketch of the late August Christian, an ex-Vice-President of the Society, for publication in the *Journal of the Association*, presented an obituary, which is published in the March, 1915, issue of the *Journal*.

The Civil Engineers' Society of St. Paul

St. Paul, Minn., January 11, 1915.

The thirty-second annual meeting of the Civil Engineers' Society of St. Paul was held in the Society rooms, Room 7, Old Capitol, January 11, 1915. The meeting was called to order at 8:25 p. m. by President Toltz. There were thirty-five members present.

Minutes of the last regular meeting were read and approved.

Report (oral) by Mr. Nagel in regard to preparation of questions to assist the Civil Service Board of the City of St. Paul.

Moved, seconded, and carried that amendment to H. R. 13,811, creating a River Regulation Commission, be referred to the new Public Affairs Committee for consideration, report, and resolution if their opinion is favorable.

Honorary membership. Ex.-Governor A. O. Eberhart to be continued on the list and Governor Hammond is to be considered for honorary membership at next regular meeting.

Moved, seconded, and carried that Mr. Stewart prepare a resolution recommending larger appropriations by Congress for the U. S. Coast and Geodetic Survey. To be submitted to the Governing Board for approval and to be forwarded to the proper parties.

Report by Mr. Brink on the metric system. More time requested and granted.

Report by Mr. Rosenwald on a financial system for this Society. More time requested and granted.

Report (oral) by Mr. Rathjens on special subjects. Committee continued.

Moved by Mr. King, and seconded, that the St. Paul Society withdraw from the Association of Engineering Societies.

A discussion followed.

The motion was submitted to a vote and lost.

Moved by Mr. Wolfe, seconded, and carried, that a committee be appointed by the President to correspond with the Secretary of the Association and Secretaries of the constituent Societies and ascertain their views in regard to the advisability of continuing the Association; also to investigate the advisability of publishing a bulletin for our Society. A report is to be made at the next meeting.

Moved, seconded, and carried, that the Secretary cast the unanimous ballot of the Society for the election of the following candidates for membership in the Society:

For Associate Member: M. N. Goss, Commissioner of Public Works, St. Paul.

For Full Members: J. P. Norton, Chief Draughtsman, Valuation Div., G. N. Ry., St. Paul.

Harry A. Gerst, Structural Draughtsman, G. N. Ry., St. Paul.

Ralph M. Hodnett, Draughtsman, City Engineer's Office, St. Paul.

For Junior Members: Geo. E. Hanson, Dunn Center, N. D.

Elmer L. Nye, State Highway Commission, St. Paul.

Received five new membership applications, which were turned over to the Examining Board.

Annual reports, appended hereto, were received and placed on file.

President and Secretary; Treasurer; Librarian; Auditing Committee; Examining Board; Membership Committee; Entertainment Committee.

Moved, seconded, and carried, that the minutes of this meeting and the reports be published in the *Journal*.

Mr. Allen Hazen, of New York, was introduced by the President and responded with a few remarks.

Election of officers by written ballot followed.

President: Mr. Rathjens, 24; Mr. Herrold, 5; Mr. Druar, 1; Mr. Meyers, 1; Mr. Danford, 1; Mr. Brink, 1; Mr. Toltz, 1; Total, 34.

Moved, seconded, and carried, that the Secretary cast the unanimous vote of the Society for Mr. Rathjens.

Mr. Rathjens then took the chair.

Vice-President: Mr. Herrold, 25; Mr. Danford, 2; Mr. Armstrong, 2; Mr. Brink, 1; Mr. Jurgenson, 1; Mr. Meyer, 1. Total, 32.

Moved, seconded, and carried, that the Secretary cast the unanimous vote of the Society for Mr. Herrold.

Secretary: Mr. Nagel, 28; Mr. Dugan, 2; Mr. Palmer, 1; Mr. Goetz, 1. Total, 32.

Moved, seconded, and carried, that the Secretary cast the unanimous vote of the Society for Mr. Nagel.

Treasurer: Mr. Brink, 32; Mr. Toltz, 1. Total, 33.

Moved, seconded, and carried, that the Secretary cast the unanimous vote of the Society for Mr. Brink.

Librarian:

Moved, seconded, and carried, that the Secretary cast the unanimous vote of the Society for Mr. Oscar Palmer for Librarian.

Moved, seconded, and carried, that Mr. L. P. Wolff, Mr. Jorgenson, Mr. G. O. House be elected representatives of Association of Engineering Societies.

Moved, seconded, and carried, that the Society invest \$200 in a municipal board or other investment at the discretion of the governing board.

Moved, seconded, and carried, that a vote of thanks be extended to the officers and committee chairman of the preceding year.

Moved, seconded, and carried, at 10:25 p. m., that the Society adjourn.

REPORT OF THE SECRETARY.

There were held eight regular monthly meetings of the Civil Engineers' Society of St. Paul, Minn., at which the average attendance was 23 members and 8 guests, the attendance having been very small at each of the last three meetings of 1914.

There were also held eight meetings of the Governing Board of this Society together with the Committee Chairman, one meeting during each month preceding a regular Society meeting, for the transaction of business not requiring vote by the Society, and for the consideration of matters and policies for later presentation to the Society for action.

During the year there were added to our list of Societies with whom we have exchange of House and Library Privileges, the four Societies named following:

- Engineers' Club of Trenton, Trenton, N. J.
- Western Society of Engineers, Chicago, Ill.
- Engineers' Club of Dayton, Dayton, Ohio.
- Cleveland Engineering Society, Cleveland, Ohio.

Article 24 of the Constitution of this Society was amended by the addition of a clause permitting certain privileges in exchange of memberships with other Engineering Societies, and under this amendment memberships may be exchanged by recent reciprocal agreement between this Society and the Cleveland Engineering Society.

The healthy growth of this Society, its sound financial condition, educational advancement, varied social and technical activities, will be shown in detail in the reports of the Treasurer, Librarian, Chairman of Entertainment Committee, and the Chairman of Membership Committee.

There is only one small thorn in a year of marked success, the same being our failure to interest or get the attendance of our railroad membership. It is hoped that measures can be taken to correct this situation during the ensuing year.

MAX TOLTZ, *President*.

EDW. J. DUGAN, *Secretary*.

REPORT OF TREASURER.

Judging from the amount due the Society from members, your Treasurer's report is not very encouraging.

Judging from the money on hand in the bank, your Treasurer might feel encouraged in making the following report:

Received of former Treasurer, January 10, 1914.....	\$ 148.47	
Received during year	1,016.35	
Paid out during year.....		\$ 811.92
Balance on hand in bank.....		352.90
	<hr/>	<hr/>
	\$1,164.82	\$1,164.83
Amount due Society, January 10, 1914.....		\$197.60
Amount due Society, January 11, 1915.....		216.75

Respectfully,

H. LE ROY BRINK, *Treasurer*.

REPORT OF THE LIBRARIAN.

INCREASES FOR 1914.

Text books	00
Periodicals bound	20
Reports bound	18
Reports unbound	10
Index to periodicals.....	1
<hr/>	
Total increases	49

TOTAL BOUND VOLUMES.

Text books on hand.....	206
Bound periodicals	369
Reports	446
<hr/>	
Total bound volumes	1021

BOOKCASES ON HAND.

Old style cases—2, value.....	\$ 50.00
Sectional cases—62 units, 12 bases, 12 tops, value.....	236.00
Magazine rack	7.00
<hr/>	
Value of Library Furniture.....	\$ 293.00
Value of 1,021 Volumes at \$5.00.....	5,105.00
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Total value of Library	\$5,398.00

We have on our reading table the following publications:

Engineering News, Engineering Record, Railroad Age Gazette, Municipal Journal, Good Road, Concrete Cement Age, Journal of the Association of Engineering Societies, Transactions of the American Society, Transactions of the Society of Western Pennsylvania, Journal of the Western Society, Journal of the Western Railway Club, Transactions of the Cleveland Society, Panama Canal Record, Transactions Nova Scotia Institute of Science, Bulletins University of Illinois, Technologist, Barge Canal Bulletins, Water Power Chronicle. Also a number of other reports and papers on technical subjects.

OSCAR PALMER, *Librarian.*

REPORT OF AUDITOR.

We, the Auditing Committee, wish to report that we have examined the books of this Society for the years ending January 1st, 1910, 1911, 1912, and 1913, and found that the figures contained therein correct.

We would also suggest, in view of the rapidly increasing business, that a new system of accounting be inaugurated.

W. F. ROSENWALD,
W. S. BATSON,
W. E. KING.

REPORT OF EXAMINING BOARD.

I beg to submit herewith the report of the Examining Board for the year 1914. During the year the names of 39 applicants have been presented and passed upon by the Board. Of this number, 32 were approved for full membership, 4 for junior membership, and one for associate member.

The papers of two applicants were not approved. One, an applicant for full membership, was returned because the applicant's statement of his professional career did not indicate that he was an engineer. This has not been heard from since. One, possibly eligible for junior membership, was held up temporarily pending an investigation of the application, when the removal from this territory of the applicant made it unnecessary for the Board to pass on the application.

As a full list of the names will be presented by the committee on membership, this list will not be duplicated here.

Yours truly,

GEO. H. HERROLD,
Chairman, Examining Board.

REPORT OF MEMBERSHIP COMMITTEE.

I submit herewith, report of the membership committee, as follows:

STATEMENT OF MEMBERSHIP JANUARY 12, 1914.

Resident members	83
Non-resident members	45
Junior members	3
Honorary members	1
Total	132

STATEMENT OF NEW MEMBERSHIP FOR THE YEAR 1914.

Resident members	30
Non-resident members	4
Junior members	2
Total	36

CANDIDATES TO BE VOTED ON THIS MEETING.

Resident members	3
Non-resident	—
Junior members	2
Associate members	1

Following is a list of names of the new members:

JANUARY 12th, 1914.

J. F. Elstone, Asst. Engineer, G. N. Ry.

W. B. Irwin, Asst. Chief Draftsman, G. N. Ry.

H. Rettinghouse, Chief Engineer, C. St. P. M. & O. Ry.

Geo. M. Shepard, Engineer, St. Paul, Minn.

W. E. Smith, Asst. Engineer, City Engineer's Office, St. Paul

MARCH 9th, 1914.

R. W. Acton, State Highway Commission, (Division Engineer).
 W. M. N. Carey, Engineer, U. S. Engineers' Office.
 J. T. Ellison, Bridge Engineer, State Highway Commission.
 Gates A. Johnson, Jr., Asst. Building Inspector. City, St. Paul.
 Paul C. Gauger, Engineer, Butler Bros.
 Walter E. Lord, Engineer, Paul J. Kalman Co.
 E. G. Minder, Engineer, Butler Bros.
 Victor H. Roehrick, City Chemist, St. Paul.
 John G. Stewart, Agrl. & Forestry Engineer, University Farm.
 M. A. Wright, Engineer, St. Paul.
 Harry Bronson, Care Butler Bros. (Junior Member).

APRIL 13th, 1914.

Frank LeRoy Brown, St. Paul Foundry Co. (Checker).
 Arthur S. Devor, Architect and Engineer, St. Paul.
 C. Walter Johnson, Engineer, State Highway Commission.
 John W. Kelsey, Asst. Engr. Water Dept., City of St. Paul.
 Ernest E. Meier, Corrugated Bar Co.
 Chas. L. Motl, Asst. Engineer, State Highway Commission.
 Edward S. Nelson, Engineer, C. H. Johnson, State Architect.
 W. P. Stevenson, Asst. Engineer, Great Northern Railway.
 J. J. Wilson, Asst. Engineer, Minn. Agrl. College.

MAY 11th, 1914.

Gates A. Johnson, Sr., Civil Engineer, Brooklyn, N. Y.
 Louis Kundson, Civil Engineer, Brainerd, Minn.
 Harry B. Roe, Asst. Engineer, Minn. Agrl. College.
 Allan Seymour, Asst. Engineer, State Highway Commission.
 Oswald Lind, Div. Engineer, State Highway Commision. (Junior).

OCTOBER 12th, 1914.

G. F. Barstow, Civil Engineer, Stillwater, Minn.
 W. S. Jennings, Engineer, Herzog Iron Works.
 James F. Muir, Civil Engineer, St. Paul.
 J. L. Mowry, Asst. Engineer, (Dept. of Agrl., U. of M.)
 Geo. F. Krough, Draftsman, (Dept. of Agrl., U. of M.)

DECEMBER 14th, 1914.

Clarence H. Stewart, Engineer, St. Paul.

TOTAL MEMBERSHIP THIS DATE—JANUARY 11, 1915.

		Members Dropped	Total
Resident members	113	3	109
Non-resident members	49	7	43
Junior members	5	....	5
	<hr/>	<hr/>	<hr/>
Total	167		157

MEMBERS DROPPED 1914.

Resident members	3
Non-resident members	6
Junior members	—
Resigned	1

MEMBERS DROPPED FROM SOCIETY.

Donald B. Fegles, Ft. Williams, Ont. (Resigned).

R. S. Feurtado, Wendel, Idaho.

Carlton B. Gibson, Troy, N. Y.

Geo. Z. Heuston, Tacoma, Wash.

John E. Hill, Minneapolis, Minn.

H. W. Ker, Indianapolis, Ind.

Wm. E. McCullough, Minneapolis, Minn.

E. G. Minder, St. Paul, Minn.

Dwight C. Morgan, Kittanning, Pa.

H. H. Harrison, Stillwater. (Resigned).

This report is respectfully submitted,
W. L. VAN ORNUM, *Chairman of Membership Committee.*

REPORT OF ENTERTAINMENT COMMITTEE.

Your entertainment committee herewith submits their report for the year 1914:

During the year three distinct lines of activity were arranged for. First, lectures and discussions of a technical nature to be given at our regular meetings; second, lectures and outings for members of the society, their families and friends; third, short talks at our noon-day luncheons.

By action of the society the noon-day luncheons were discontinued for the summer months.

The following technical papers were presented at our regular meetings:

February 9—"Triangulation Work in Arizona," Illustrated by Prof. J. T. Stewart, Member.

March 9—"The Detroit Tunnel," Illustrated by Mr. W. Butler, Butler Bros., General Contractors.

April 13—"The St. Paul Water Works," by R. L. Smith, Member.

May 11—"Estimating Stream Flow From Rainfall Records," Illustrated by A. F. Meyer, Member.

October 12—"The Everglades of Florida," by Prof. J. T. Stewart, Member.

November 9—"Garbage Collection and Disposal," by Prof. F. Bass, University of Minn.

December 14—"Genesis of the Traction Engine," by Prof. Mowry, University of Minn.

During the year the following special lectures were given:

February 14—"Organized Charity," by Mr. G. C. Stillman, Secretary United Charities.

March 14—"Radium," by Prof. Alois F. Kovarick, University of Minn.

April 22—"Structural Waterproofing and Dampproofing," by R. A. Plumb, Trussed Concrete Steel Co.

November 19—"Social Efficiency in St. Paul," Illustrated by Mr. G. C. Stillman.

Three outing were held :

August 15—"River Excursion and Bouillion."

September 19 and 20—"House Party at Bald Eagle."

October 10—Your society as guests of Warden Reed, had luncheon at the Minnesota State Prison, spending a very instructive afternoon visiting this institution.

Respectfully submitted,

G. RATHJENS, *Chairman.*

The Oregon Society of Engineers

February 1, 1915.

REPORT OF THE TREASURER.

To the President and Members of the Oregon Society of Engineers :

Gentlemen:—In compliance with Section 5, Article X, of the Constitution, and for your information, I respectfully submit herewith my report showing the receipts and expenses of the Society for the year ending January 31, 1915:

Cash on hand Feb. 1, 1914, in bank.....	\$594.51
Checks on hand, not deposited.....	57.00
Total on hand Feb. 1, 1914.....	\$ 651.51

RECEIPTS.

5 Dues of Active Members for year 1913, at \$6.00.....	30.00
136 Dues of Active Members for year 1914, at \$6.00.....	816.00
2 Dues of Active Members for first half of year 1914, at \$3.00	6.00
4 Dues of Active Members for last half of year 1914, at \$3.00	12.00
1 Dues of Active Member for first 8 months of year 1915	4.00
1 Dues of Active Member for year 1915, at \$6.00.....	6.00
13 Initiation Fees of Active Members at \$5.00.....	65.00
1 Dues of Associate Member for year 1914, at \$10.00..	10.00
1 Dues of Associate Member for last half of year 1914	5.00
15 Dues of Junior Members for year 1914, at \$3.00.....	45.00
2 Dues of Junior Members for first half of year 1914, at \$1.50	3.00
1 Dues of Junior Member for year 1914, with Journal	4.50
Cash for one luncheon at Hotel Benson.....	.50
Cash from Institute of Electrical Engineers for share in adv. luncheons	3.00
Total receipts for year 1914.....	\$1,010.09
	<u>\$1,661.60</u>

DISBURSEMENTS.

Salary of Secretary, 12 months, at \$10.50.....	\$126.00
Stenographic work, notices of meetings, letters to members, etc.	64.60
Stationery and Printing	75.60
Postage, postal cards, etc.....	131.73
Rent of P. O. Box 973 for year 1914.....	12.00
Stereopticon lantern for one evening.....	3.00
Record Book for Treasurer.....	1.80
Two Cuts for Society Emblem.....	2.00
One Die for use in making Badges.....	7.00
Entertainment at Annual Meeting, Feb., 1914.....	26.00
First Monday luncheon at Hotel Benson, 37 guests at \$0.50	18.50
Luncheons furnished speakers at Monday luncheons, 10 at \$0.50.....	5.00
Membership in Oregon Irrigation Congress.....	5.00
Compensation voted Treasurer for special work in 1913, 3 months at \$5.00.....	35.00
Negative argument in campaign pamphlet on act to abolish Desert Land Board.....	12.50
Journals of the Association of Engineering Societies.....	325.40
Advertisement of Employment of Department in Pacific Builder, 1st installment.....	5.00
<hr/>	
Total expenses for year 1914.....	\$ 856.13
Balance on hand, in bank, Jan. 31, 1915.....	805.47
<hr/>	
	\$1,661.60

All bills are paid to date.

The expense of printing Directory was covered by the advertising which it contains.

There was no cost for hall or office rental during the year, as the Society had the use of Lecture Room A in the Public Library free of charge.

Respectfully,

HENRY BLOOD, *Treasurer.*

The Secretary's Report is published elsewhere in this issue.

ASSOCIATION OF ENGINEERING SOCIETIES

Vol. 54.

APRIL, 1915.

No. 4

PROCEEDINGS.

The Montana Society of Engineers

Butte, Montana, March 8, 1915.

The regular monthly meeting was held in Society Room in the Silver Bow County Court House, with President Sales presiding. Quorum present. Minutes of last meeting approved. The applications of Paul Billingsley, John A. Grimes, Norman B. Braly, Chauncey L. Berrien, Murl H. Gidel and Frank A. Linforth for membership in the Society were presented, approved and the usual ballot ordered.

The committee appointed to prepare a sketch of the life of the late F. Aug. Heinze, a member of this Society, for publication in the Journal of the Association, presented an obituary, which was approved, and the Secretary instructed to forward a copy to the family of the late member.

CLINTON H. MOORE, *Secretary*.

The Engineers' Club of St. Louis

The 799th meeting of the Club was held in the Club Rooms, Wednesday, February 10, 1915, at 8:15 p. m., as a Party Meeting with and under the auspices of the St. Louis Section of the American Institute of Electrical Engineers. Mr. S. N. Clarkson, Chairman of the St. Louis Section of the A.I.E.E., presided. The total attendance was 37.

Chairman Clarkson presented Mr. J. A. Osborne, Electrical Engineer with the American Car and Foundry Co., who delivered an interesting talk on "Special Industrial Applications of Electricity."

Adjourned 10:15 p. m.

JOSEPH W. PETERS, *Assistant Secretary*.

The 800th meeting of the Club was held in the Club rooms, Wednesday, February 17, 1915, at 8:15 p. m., as a Joint Meeting of the Associated Engineering Societies of St. Louis, under the auspices of The Engineers' Club

of St. Louis. President John W. Woermann presided. The attendance was 49 members and 6 guests.

After the reading of the minutes and disposal of business before the Associated Societies, President Woermann introduced Mr. T. H. Rogers, Chairman of the Efficiency Board of the City of St. Louis, who spoke on the "Work of the Efficiency Board." A brief discussion followed.

Discussion and action on the proposed extension of street car service through Forest Park was postponed until some future meeting due to the fact that both sides of the proposition could not be fully laid before this meeting.

Adjourned 10:30 p. m.

JOSEPH W. PETERS, *Assistant Secretary.*

The 801st meeting of the Club was held in the main auditorium of the Central High School, Wednesday, February 24, 1915, at 8:15 p. m. President John W. Woermann presided. The Associated Engineering Societies of St. Louis, St. Louis Academy of Science, St. Louis Medical Society, St. Clair County Medical Society and Jovian Chapter of the League of Electrical Interests were invited to attend. The total attendance was 149.

The President introduced Dr. Max von Rechlinghausen, who presented an illustrated paper on "The Use of the Ultra-violet Rays for the Sterilization of Water Supplies." A brief discussion followed.

Adjourned 10:30 p. m.

JOSEPH W. PETERS, *Assistant Secretary.*

The 802nd meeting of the Club was held in the Club rooms, Wednesday, March 3, 1915, at 8:15 p. m. President John W. Woermann presided. There were present 55 members and 22 guests.

The minutes of the 798th, 799th, 800th and 801st meetings of the Club were read and approved.

The minutes of the 564th meeting of Executive Committee were read.

The presiding officer introduced Mr. O. C. Steinmayer, General Treating Inspector of the St. Louis and San Francisco Railroad and a member of The Engineers' Society of Springfield, Mo., who read a paper on "The Creosoting of Cross Ties as Practiced by American Railroads." Following the reading of the paper a number of interesting lantern slides were shown illustrating the subject.

A vote of thanks was tendered Mr. Steinmayer.

The Entertainment Committee then ushered members and guests into the Reading Room and Library where was celebrated with speech, song and lunch, the opening of the doorway between the two rooms and the general rejuvenation of the Club Quarters.

JOSEPH W. PETERS, *Assistant Secretary.*

The 803rd meeting of the Club was held at the City Club, Friday, March 12, 1915, at 8:30 p. m., as a Joint Meeting of the Associated Engineering Societies, under the auspices of the St. Louis Section of the

American Institute of Electrical Engineers. President John W. Woermann opened the meeting, calling upon Mr. S. N. Clarkson, Chairman of the local section of the A.I.E.E., to preside. This meeting was designated a "Ladies' Night." There were present 150 members and guests.

Mr. S. N. Clarkson gave a very interesting illustrated travelogue on his recent trip from St. Louis to Australia and return.

The St. Louis Union Electric Light and Power Company Orchestra played a number of selections and the Washington University Quartet entertained the audience. Singing, refreshments and dancing followed.

Adjourned 11:30 p. m.

JOSEPH W. PETERS, *Assistant Secretary.*

The 804th meeting of the Club was held in the Club Rooms, Wednesday, March 17, 1915, at 8:15 p. m. President John W. Woermann presided. There were present 41 members and 10 guests.

The minutes of the 802nd and 803rd meetings of the Club were read and approved.

The minutes of the 565th meeting of the Executive Committee were read.

The presiding officer then presented Mr. P. M. Bruner, who read a very interesting short paper on "A Simple Method of Securing Dustless Concrete Floors." A short discussion followed.

Following Mr. Bruner, Mr. Carl Gaylor, Chairman of the Reinforced Concrete Column Committee, read the report of the Committee as published in the February issue of the Journal and followed it with a supplementary report and discussion. Discussion followed and a request was made that the report again be brought up for consideration of the Club.

Following Mr. Gaylor, Mr. C. W. Martin discussed from several illustrations thrown on the screen, "The Need of a New Co-efficient in Reinforced Concrete Beam Design." An interesting discussion followed. It was suggested that this also be brought up for future discussion.

Adjournment 10:45 p. m.

JOSEPH W. PETERS, *Assistant Secretary.*

The 805th meeting of the Club was held in Busch Hall, Washington University, March 23, 1915, at 8:15 p. m., as a Joint Meeting with and under the auspices of the Collimation Club of Washington University in accordance with the agreement of the Club with students' technical societies in universities in Missouri. Prof. J. L. Van Ornum presided. The total attendance was 125.

The presiding officer presented Mr. F. H. Newell, former director and now consulting engineer for the U. S. Reclamation Service. Mr. Newell spoke on "The Engineering and Economic Features of the Reclamation Construction." His entire talk was illustrated by beautifully colored stereopticon views.

A vote of thanks extended the speaker.

Adjournment 10:45 p. m.

JOSEPH W. PETERS, *Assistant Secretary.*

The 806th meeting of the Club was held in the Club Rooms, Wednesday, March 31, 1915, at 8:15 p. m. President John W. Woermann presided. There were present 44 members and 2 guests.

The minutes of the 804th and 805th meetings of the Club were read and approved.

Motion made and unanimously carried that the Club invite the attention of the Joint Council of the Associated Engineering Societies to articles recently published in St. Louis newspapers referring to a proposed project to connect the Missouri and Meramec Rivers by means of a canal to develop hyrdo-electric power, which articles contain salient misstatements of fact, with the recommendation that the Joint Council recommend that correct information be furnished the public and press.

Motion made and unanimously carried that the President write a letter on behalf of the Club to a certain local newspaper directing attention to an article in which The Engineers' Club was reported as having requested the State Public Utilities Commission to investigate the rates of the Union Electric Light & Power Company, when as a matter of fact this was done by the "Engineers' Incitation Club," a separate and distinct organization in no wise affiliated with this Club.

Motion made and unanimously carried that the Secretary write a letter on behalf of the Club to Mr. Washington Adams, of Springfield, Mo., expressing thanks and appreciation for his activities before the State Legislature in introducing and fostering a bill originating in a Committee of this Club seeking to provide Quantity Surveying for all public work within the State.

Motion made and unanimously carried that the Club recommend that the Joint Council of the Associated Engineering Societies appoint a committee to make a study of the common civic problems likely to affect the future relationship between St. Louis and its suburban cities and between such cities themselves, and to report on the advisability of forming a permanent commission for the consideration of such problems.

The presiding officer presented Mr. Walter A. Heimbuecher, City Engineer of University City, Mo., who presented an illustrated paper, entitled "Typical Engineering Problems of Missouri Municipalities." Discussion followed.

Following Mr. Heimbuecher's paper short talks on the night courses in Electrical Engineering, established this year at Washington University, were made. Prof. A. S. Langsdorf told what the University was doing and Mr. F. J. Bullivant, in the absence of Mr. A. H. Timmerman, told of the advantages offered the manufacturer.

Adjourned 10:30 p. m.

JOSEPH W. PETERS, *Assistant Secretary.*

The 807th meeting of the Club was held in the Club Rooms, Wednesday, April 7, 1915, at 8:15 p. m., as a Joint Meeting with the Associated Engineering Societies of St. Louis, under the auspices of the St. Louis Association of Members of the American Society of Civil Engineers. President John W. Woermann called the meeting to order, calling upon

Mr. J. A. Ockerson, President of the St. Louis Association of Members of the American Society of Civil Engineers, to preside.

There were present 130 members and guests.

President Ockerson presented Mr. Edward E. Wall, Water Commissioner of the City of St. Louis, who read a very interesting illustrated paper on "The Future Water Supply of St. Louis." Discussion followed.

The meeting adjourned at 9:45 p. m., after which refreshments were served.

JOSEPH W. PETERS, *Assistant Secretary.*

The 808th meeting of the Club was held in the Club Rooms, Wednesday, April 14, 1915, at 8:15 p. m., as a Party Meeting with and under the auspices of the St. Louis Branch of the American Institute of Electrical Engineers. S. N. Clarkson, Chairman of the St. Louis Branch of the A.I.E.E., presided. The total attendance was 36.

Mr. A. R. Fairchild, of the Union Electric Light & Power Company, presented the paper of the evening, entitled "Hydro-electric Development in the Pacific Northwest." The paper was illustrated by about 100 interesting stereopticon views.

Adjourned 10:00 p. m.

JOSEPH W. PETERS, *Assistant Secretary.*

ASSOCIATION OF ENGINEERING SOCIETIES

Vol. 54.

MAY, 1915.

No. 5

PROCEEDINGS.

The Montana Society of Engineers

Proceedings of the Twenty-eighth Annual Meeting of the Montana Society of Engineers, held at Butte, Montana, April 8-9-10, 1915.

Thursday.

Was as fair as a day in June. No obstacle was in the way of the success of the annual meeting, except prosperity. This pleasing feature, like springtime, rather delayed its appearance to some that have been without its cheering influence for numerous seasons, and when it did come to them, those members chose the wiser part, toiling and spinning in the busy shops and developing new sources of the world's wealth, inspired by a hope of better financial days and other gatherings of Montana's engineers. However, many came and when the Silver Bow club opened wide its hospitable doors there they received such a welcome as only comes to mountain men. New members soon found themselves at ease and the evening too quickly ended.

Friday.

The weather sustained its record of yesterday. The breakfast hour was devoted to the duties of the occasion and a careful study of the printed program for the day and evening. Promptly at the appointed hour, sixteen autos awaited their passengers at the Society headquarters, and a speedy getaway was made for "the hill" over good roads and past famous gulches. Some sought the intricacies of the mines, noting the famous ore deposits, the methods of ore transmission, the marvelous tonnage produced. The gigantic electric hoist at one of the mines commanded the enthusiastic admiration of all its beholders. The Butte camp has always something new for the engineering profession. The two zinc ore reduction plants foretold the coming of the zinc age in the history of this mining region. Some of the engineers hereabouts have been a part and parcel of Butte's golden age, its silver age, its copper age, and are now standing at the door of the zinc age, modestly telling of their engineering failures and success. The morning hours gave much

pleasure and valuable lessons to all the tourist engineers. A lunch occupied the noon hour at the Silver Bow Club and away sped the sight-beholders and visitors to the Smelter City. It did not take very long for the loaded autos to make the trip. Historic sights were on every hand, notably the city of Rocker, once with its golden streets, the abandoned arastra, built and operated in Montana's golden age; the famous "hump," a resort known to painters and pioneers of long ago, the ruins of the business at "Gregson" slowly rising from their ashy bed, the beautiful valley of the Deer Lodge, Mount Haggin with towering and snowy crest, and further away Mount Powell, in all its colossal splendor. A cordial welcome from the general manager and brother engineers of the Washoe Reduction Plant was instantly dealt out to one and all. The new methods of ore concentration, the solution of the ore slimes problem, the acid production scheme received full explanation and attention, to say nothing of the other features of engineering skill and chemical ability that have brought envious reputations to their possessors. At last, the return became compulsory and a quick run brought the weary tripsters to the evening's entertainment. It is hard to depict Montana's electric power development in words, but the marvelous views displayed by the enthusiastic manager of the Montana Power Co. and his corps of assistants in this branch of the engineering profession, told the story to many engineers and Butte citizens. These views were rivaled, and to some critics, surpassed, by the scenes depicted of the underground work in a Butte mine, showing the dangerous features of the miners' occupation, their work and play, their eagerness to work and their anxiety to quit, and better yet, the graphic pictures portraying in no uncertain ways the lessons demanding "Safety First" as taught by their distinguished author and his fellow workers, gave the beholders something new in "movies." Not "weak but weary," the participants in the day's and evening's pleasures strolled away, thinking of what had been done for them and what they had seen.

Saturday.

The business meeting of the Society was called to order in the Society room in Silver Bow County Court House at 10 a. m., with President Reno H. Sales in the chair. Quorum present. The president expressed himself gratified with the number of members present, after which the minutes of the March meeting were read and called forth no objections. The applications for membership in the Society of Messrs. Walcott, Tunnell, Daly, Krueger, Rusterholtz and Batchelder were read by the secretary and ballot ordered. Messrs. Linforth, Braly, Grimes, Gidel, Billingsly and Berrien were elected to active membership in the Society. The ballots for the officers for the coming year were then counted, tellers being appointed. The ballot was unanimous in favor of the entire ticket and President Sales declared the officers elected for the coming year, to-wit: President, Martin H. Gerry, Jr.; first vice-president, Arthur W. Richter; second vice-president, James H. Kyd; secretary and librarian, Clinton H. Moore; treasurer and member of the Board of

Managers of Engineering Societies, Samuel Barker, Jr.; trustee for three years, Frank T. Donahoe. President Sales presented President-elect Gerry, who promptly assumed his duties and labors. The reports of the secretary and treasurer were read in turn and referred to the regular committees. The subject of continuing the Society's membership in the Association of Engineering Societies was introduced by the Secretary, with other matter relating to the Society's future, and after due consideration it was voted to cease business relations with the Association not later than October 1st, 1915. The committees appointed to prepare sketches of the lives of the late George A. Griggs and Arthur W. Bower, deceased members of the Society, submitted reports, which were approved and ordered published in the Journal of the Association and copies sent to the families of the late members.

The secretary explained the reason that Geo. D. Eastman had not completed the application for membership in the Society within the required time, based on the fact of the miscarriage of notice through change of residence, and on motion Mr. Eastman was placed on the active membership list, conditional to his payment of dues for 1915. An invitation was read, inviting the Society to favorably consider a membership in the Mining Congress. A negative vote resulted. A recess was taken until 2 p. m. A lunch at the Silver Bow Club helped some. The afternoon session was held in the room of the Butte Chamber of Commerce through mistake. The meeting commenced with reading of the retiring president's address by its author, which is always valuable and interesting from a historical standpoint. Mr. Frank R. Ingalsbe, of the U. S. Forestry Service, gave an excellent paper, having for his theme, "Notes on National Forestry in Montana." His paper was followed by another, read by its author, Mr. Eugene D. Gardner, of the U. S. Forestry Service, having for its subject, "Cost of Initial Mining Operations." These two papers met with much favorable comment and discussion. The last paper of the session had for its title, "Features of Electrical Equipment for the Granite Mountain Hoist," by Mr. Gerard B. Rosenblatt. Unfortunately, the author was unable to honor the Society with his presence, but the paper was very creditably presented by Mr. Lamont. An exceedingly interesting discussion followed and many features explained hardly expressible in a written composition. Thanks were voted to all who had contributed to the success of this last annual meeting of the Society. After which adjournment followed. The usual banquet consumed the time of the evening session.

CLINTON H. MOORE, *Secretary*.

The Engineers' Club of St. Louis

The 809th meeting of the Club was held in the Club rooms, Wednesday, April 21, 1915, at 8:15 p. m. President John W. Woermann presided. Members of the St. Louis Architectural Club were invited to attend. The total attendance was 110.

The minutes of the 806th, 807th and 808th meeting of the Club were read and approved.

The minutes of the 566th meeting of the Executive Committee were read.

The Chairman called for the reading of the proposed amendment of Section 2 of the By-laws as follows:

Replace the sentence:

"An accounting fee of twenty-five cents per month shall be charged on all delinquent dues."

with the following sentences:

"Early in January and July of each year, the Treasurer of the Club will render regular bills for dues. Additional **bills** for unpaid dues may be rendered early in April and October or at such times as the Executive Committee may direct. Each time an additional bill for unpaid dues is rendered to a member, he shall be charged an accounting fee of twenty-five cents, but provided that the total of such accounting fees for any member shall not exceed one dollar per year."

Motion made and unanimously carried that the proposed amendment to By-laws be adopted.

The presiding officer introduced Mr. T. L. Condron, Consulting Engineer of Chicago, who delivered a very interesting illustrated talk on "The Destruction and Reconstruction of the Edison Phonograph Works." A brief discussion followed.

A rising vote of thanks was extended the speaker.

Adjourned 10:30 p. m.

JOSEPH W. PETERS, *Assistant Secretary.*

The 810th meeting of the Club was held in the Club rooms, Wednesday, April 28, 1915, at 8:15 p. m. President John W. Woermann presided. The total attendance was 58.

Minutes of the 809th meeting of the Club were read and approved.

Motion made and unanimously carried extending a vote of thanks to the president, secretary and assistant secretary for their efforts in the publication of the attractive 1915 Club Annual.

The presiding officer presented Mr. Charles A. Hobein, Jr., who read an instructive illustrated paper entitled, "The Investment Banker and the Engineer." A brief discussion followed.

Following Mr. Hobein's paper, Mr. Oliver W. Childs, of the U. S. Office of Public Roads, delivered an interesting illustrated talk on the organization and work of that office. A brief discussion followed.

Adjourned 10:45 p. m.

JOSEPH W. PETERS, *Assistant Secretary.*

The 811th meeting of the Club was held in the Club rooms, Wednesday, May 5, 1915, at 8:15 p. m., President John W. Woermann presiding. The total attendance was 84.

Minutes of the 810th meeting of the Club were read and approved.

Minutes of the 567th meeting of the Executive Committee were read.

The presiding officer presented Mr. Norvelle Wallace Sharpe, M. D., F.A.C.S., who delivered a very interesting and instructive lecture dealing with surgical and medical practice. The talk was illustrated by x-ray photographs and various specimens.

A rising vote of thanks was extended the speaker.

Mr. Edward P. Walsh, who was to have followed Dr. Sharpe with a short talk on "Safety First in Street Railway Work," consented to have his address postponed owing to the late hour.

The meeting adjourned at 11:00 o'clock, after which refreshments were served in the Club rooms.

JOSEPH W. PETERS, *Assistant Secretary*.

ASSOCIATION OF ENGINEERING SOCIETIES

Vol. 54.

JUNE, 1915.

No. 6

PROCEEDINGS.

The Engineers' Club of St. Louis

The 812th meeting of the Club was held in the Club Rooms, Wednesday, May 12, 1915, at 8:15 p. m., as a Party Meeting with and under the auspices of the St. Louis Section of the American Institute of Electrical Engineers. President Woermann called the meeting to order and then called upon Mr. S. N. Clarkson, Chairman of the St. Louis Section of the A.I.E.E. to preside. The total attendance was 58.

The presiding officer introduced Mr. Brent Wiley, Commercial Engineer of the Westinghouse Electric and Manufacturing Co., who presented an illustrated paper on "The Development of the Motor Drive and the Use of Central Station Power in the Steel Industry."

Adjourned, 10:30 p. m.

JOSEPH W. PETERS, *Assistant Secretary.*

The 813th meeting of the Club was held at Washington University, Wednesday, May 19, 1915, at 8:15 p. m., as a Joint Meeting of the Associated Engineering Societies of St. Louis under the auspices of the Club. President John W. Woermann presided. The total attendance was 42.

The meeting was devoted to an open discussion of the duration and contents of an engineering course of study. Professors A. S. Langsdorf, J. L. Van Ornum, E. L. Ohle and G. O. James, of Washington University, and Prof. E. J. McCausland, of the University of Missouri, lead the discussion which was participated in by a number of others present. Following the discussion there was an inspection of the laboratories.

Adjourned, 11:15 p. m.

JOSEPH W. PETERS, *Assistant Secretary.*

The 814th meeting of the Club was held Saturday, May 22, 1915, at 1:30 p. m., as a Joint Meeting of the Associated Engineering Societies of St. Louis under the auspices of the Club for a trip of inspection through the works of the Continental Portland Cement Co. The total attendance was 75.

Special cars were furnished by the United Railways Co. and the Continental Portland Cement Co. Members were escorted through the works by officers and employees of the Company and after a very interesting two hours spent in inspection a light luncheon was served and the meeting adjourned about 5:30 o'clock.

JOSEPH W. PETERS, *Assistant Secretary.*

The 815th meeting of the Club was held in the Club Rooms, Wednesday, May 26, 1915, at 8:15 p. m., President John W. Woermann presiding. The total attendance was 54 members and guests.

The minutes of the 811th, 812th, 813th and 814th meetings of the Club were read and approved.

The President presented Mr. Herman von Schrenk, timber specialist, who presented the paper of the evening entitled, "The Modern Uses of Wood." The paper was illustrated by a large number of stereopticon views and specimens. Discussion followed.

Designs for a Club emblem were on exhibition in the Library before the meeting and following the paper of the evening the President called for a preferential ballot to determine the three prize winners. Each design was numbered and voted for by number. There were thirty designs on display and the voting resulted as follows:

First prize—Design No. 29 receiving 14 votes.

Second prize—Design No. 9 receiving 8 votes.

Tied for third prize—Design No. 10 receiving five votes.

Tied for third prize—Design No. 27 receiving five votes.

The President announced that these four designs would be submitted to the entire membership for a preferential ballot.

Adjourned, 10:45 p. m.

JOSEPH W. PETERS, *Assistant Secretary.*

The 816th meeting of the Club was held in the Club Rooms, Wednesday, June 2, 1915, at 8:15 p. m., President John W. Woermann presiding. The total attendance was 70 members and guests.

The minutes of the 815th meeting of the Club were read and approved.

The minutes of the 568th meeting of the Executive Committee were read.

The presiding officer presented Mr. T. N. Jacob, Consulting Engineer of East St. Louis, Ill., who read the paper of the evening entitled, "The East Side Levee and Sanitary District." Mr. Jacob was Chief Engineer on this work from 1909 to 1913.

Mr. Charles M. Talbert, Director of Streets and Sewers, was on the program to give a short talk on the Proposed Central Parkway, but was suddenly called out of town and Mr. J. M. Slater, Street Commissioner, spoke in his stead. Discussion followed.

The meeting adjourned at 10:30 o'clock, after which refreshments were served in the Club Rooms.

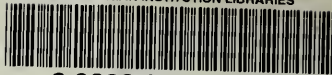
JOSEPH W. PETERS, *Assistant Secretary.*

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